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STUDIES IN THE BORAGINACEAE, XVIII BORAGINACEAE OF THE SOUTHERN WEST INDIES

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PRELIMINARY TO THE PREPARATION of an account of the Boraginaceae of Trinidad and Tobago it has been found desirable to survey the representation of the family in the West Indies. Some of the results are here presented in a synopsis of the species known from the Lesser Antilles, Tobago, and Trinidad. Special attention has been given to the details of distribution in the southern West Indies and to the taxonomic history of the species concerned. The study is primarily based on the collections of the Gray Herbarium (G), but numerous specimens from the New York Botanical Garden (NY), the United States National Herbarium (US), and the Trinidad Botanic Garden Herbarium (T), have also been examined.

KEY TO GENERA

Style twice cleft, with the four branches each bearing a stigma...1. *Cordia*.
Style cleft or simple.

Style evidently cleft, bearing two stigmas.

Corolla subrotate; flowers and leaves produced on dense axillary short-shoots; plant frequently spiny.....2. *Rochefortia*.

Corolla salverform; plant unarmed.....3. *Bourreria*.

Style simple or very short or none; stigma annular, usually surmounted by a sterile, conic or cylindric, occasionally lobed appendage.

Fruit with fleshy mesocarp; large shrubs.....4. *Tournefortia*.

Fruit dry, without any fleshy mesocarp; herbaceous.....

.....5. *Heliotropium*.

1. CORDIA

KEY TO THE SPECIES

Corolla vermilion, about 4 mm. long, frequently 6-lobed; mature fruit hard, dry, ovoid, 20-25 mm. long, completely and tightly invested by the calyx that becomes white and fleshy.....1. *C. Sebestena*.

Corolla white or cream-colored, 5-lobed; calyx not fleshy at maturity.

Pubescence stellate; corolla marcescent, persistent; fruit slender, elongate, thin-walled, dry, developing ensheathed by corolla-tube and 10-ribbed cylindrical calyx, when fully mature the whole flower falling with the enclosed fruit, the still spreading corolla-lobes functioning as a parachute.....2. *C. alliodora*.

Pubescence simple or none; corolla withering, falling after anthesis; fruit drupaceous.

Corolla very large, .35-50 mm. long, the slender exerted tube abruptly and broadly expanded into a well-developed cylindrical throat; inflorescence capitate; tips of calyx-lobes conspicuously long-attenuate.....3. *C. grandiflora*.

Corolla less than 15 mm. long and usually much shorter, without a well-differentiated tube and throat.

Fruiting calyx half to almost completely investing the drupe, the latter red, 4-6 mm. long, with a thin quickly dessicated flesh; stone irregularly warted; corolla-limb usually only shallowly and very broadly lobed; plant usually with a sage odor.

Inflorescence not distinctly spicate.

Calyx-lobes with prolonged hairy setaceous tips about 5 mm. long; inflorescence a globose head 1.5-3 cm. in diameter.....4. *C. globosa*.

Calyx-lobes acute, without prolonged tips.

Upper leaf-surface bearing short stiff hairs in great abundance; inflorescence terminal or internodal but never axillary, repeatedly forked and becoming a loose open cyme at maturity; corolla with reflexed, crisped, lacerate-dentate lobes about as long as broad.....5. *C. salvifolia*.

Upper leaf-surface glabrous or apparently so, stiff hairs few, scattered and inconspicuous; inflorescences mostly axillary, simple or sparingly branched, the cymes capitate or glomerate and loosening little if at all in most advanced maturity; corolla with obscure lobes several times as broad as long, margins entire or nearly so..6. *C. polycephala*.

Inflorescence spicate.

Spikes mostly axillary, with the peduncle and the petiole of the subtending leaf united for 3-9 mm. at their base; upper surface of leaves more or less lustrous, with scattered tightly appressed hairs.....7. *C. Schomburgkii*.

Spikes all terminal or internodal, never axillary; upper surface of leaves glabrous or bearing ascending or erect hairs.

Corolla-limb subentire, its very short inconspicuous lobes several times broader than long; calyx-lobes usually with short but distinct tips that are free in the bud; spike dense, in fruit 10-15 mm. thick; fruit matured in a subinflated calyx....8. *C. martinicensis*.

Corolla smaller, the limb with evident reflexed lobes about as broad as long; calyx-lobes without prolonged tips that are free in the bud; spikes frequently becoming loose and interrupted, in fruiting state usually 8 mm. or less thick; fruit partially protruding from the cup-shaped calyx.

Leaves lanceolate to lance-ovate, broadest at or below middle, apex acute, margin entire or somewhat dentate or crenate; upper surface usually glabrous or rarely with short stiff hairs; corolla-lobes entire or obscurely erose-dentate, weakly if at all crisped.....9. *C. curassavica*.

Leaves broadest at or above middle, apex usually rounded, margin usually evidently crenate or dentate, upper surface at least on young foliage usually with evident soft hairs; corolla-lobes usually erose-dentate and crisped.....10. *C. divaricata*.

Fruiting calyx usually explanate or saucer-shape, covering only the very base of the drupe, the latter 8-16 mm. long and with a very well-developed juicy mesocarp; stone ribbed or lacunose.

Calyx 10-ribbed, in the bud appendaged at apex, usually irregularly circumscissile below summit; corolla showy, broadly funnelform, its lobes emarginate and about as broad as long.....11. *C. dentata*.

Calyx not distinctly ribbed, not appendaged at apex, usually opening regularly and 5-lobed; corolla with cylindrical tube and spreading elongate lobes.

Petioles of well-developed leaves 1.5-4 cm. (usually 2-3 cm.) long.

Leaves 5-11 cm. long, lower surface (as well as petiole and branches of inflorescence) practically glabrous at maturity; fruit a very plump and juicy drupe, 1.5 cm. long, pink or salmon in color.....12. *C. obliqua*.

Leaves 10-20 cm. long, with brownish indument of abundant short soft appressed hairs on lower surface, as well as on petiole and branches of inflorescence; fruit a whitish drupe, 8-10 mm. long....13. *C. tetrandra*.

Petioles of well-developed leaves 0.2–1.5 cm. (usually 0.5–1 cm.) long.

Leaves usually broadest above middle, apex acute or with a coarse, generally obtusish short prolongation; tree deciduous, producing its inflorescence on bare twigs before or simultaneously with the appearance of the new leaves of the season; fruit red; flowers markedly heteromorphic, those on each tree functionally either male or female.....

.....14. *C. Collococca*.

Leaves usually broadest below the middle, at least the larger ones with a sharp prolonged attenuate tip; plant bearing its inflorescence on leafy shoots; fruit white or yellowish.

Lower leaf-surface with an evident pallid indument of abundant minute whitish hairs, the hairs confined to the veins and veinlets and appressed and directed concentrically over the numberless areoles in the veinlet-reticulum; fruit strigose; flowers homomorphic, perfect, functionally bisexual.....

.....15. *C. bicolor*.

Lower leaf-surface velvety and somewhat glabrescent, green, gray or tawny, the areoles in the veinlet-reticulum not covered by appressed, concentrically directed hairs; fruit glabrous.

Flower-buds large, 7–9 mm. long, broadly clavate; calyx coarsely and irregularly 2–3-lobed, its margins fragmenting and erose; flowers homomorphic, all perfect and functionally bisexual.....

.....16. *C. elliptica*.

Flower-buds smaller, 2.5–4 mm. long; calyx with 5 small subequal teeth; flowers markedly dimorphic, those on a particular tree functionally either male or female; female flowers with a clavate-cylindric bud, at anthesis with a cylindric calyx, an inconspicuous corolla, small stamens and evidently protruding styles; male flowers with a subglobose or globose bud, at anthesis with a cup-shaped calyx, evident corolla-limb, conspicuously exerted stamens and reduced included female organs.

Larger leaves usually subcordate at base, tip acute or moderately attenuate, blade up to 19 cm. broad, usually strigose or rather smooth above though at times somewhat velvety, at most only moderately scabrous; twigs, petioles and inflorescence tomentose-floccose, velvety or strigose, the short hairs spreading or appressed. 17. *C. sulcata*.

Larger leaves acute, obtuse or rounded at base, the tip attenuate and prolonged.

- Leaf decidedly scabrous above, with rigid hairs only moderately appressed; blade up to 15 cm. broad; twigs, petioles, and inflorescence bristly with stiff hairs 1-2 mm. long, if also bearing other hairs these minute appressed and (especially on the twigs) usually retrorse. 18. *C. panamensis*.

Leaf with very minute closely appressed hairs and rather smooth; blade up to 11 cm. broad; twigs, petioles and inflorescence not at all bristly, very finely strigose with the minute short hairs very closely appressed and all antrorse. 19. *C. sericalyx*.

1. *Cordia Sebestena* L. Sp. Pl. 190 (1753). — Type West Indian.

Native of the West Indies and ranging from the Bahamas to northern Venezuela; now widely cultivated in the tropics.

GUADELOUPE: Duss 2754 (G). MARTINIQUE: Hahn 763 (G). BARBADOS: Eggers 7183 (G).

2. *Cordia alliodora* (R. & P.) Cham. ex DC. Prodr. 9: 472 (1845); Urban, Symb. Ant. 8: 574 (1921); Johnston, Contr. Gray Herb. 73: 77 (1924) and l.c. 92: 13 (1930).

Cerdana alliodora R. & P. Fl. Peruv. 2: 47, t. 184 (1799). — Type Peruvian. *Cordia Gerascanthus*, var. *subcanescens* DC. Prodr. 9: 472 (1845). — Type West Indian.

Cordia Gerascanthus, var. *domingensis* Cham. ex DC. Prodr. 9: 472 (1845), in synonymy.

Cordia Gerascanthus, forma *martinicensis* Chodat, Bull. Soc. Bot. Genève, sér. 2, 12: 210 (1920).—Type from Martinique, Hahn 626.

Cordia Gerascanthus, forma *micrantha* Chodat, Bull. Soc. Bot. Genève, sér. 2, 12: 210 (1920).—Type West Indian.

Cordia Gerascanthus of many authors, not of Linnaeus.

Widely distributed in tropical America.

MONTSERRAT: *Shafer* 557 (NY, US). ANTIGUA: *Box* 1316 and 1342 (US); *Rose, Fitch & Russell* 3320 and 3456 (US). GUADELOUPE: *Duss* 2580 (G, US, NY); *Questel* 694 (US); *Stehlé* 85 (NY), 126 (US), 559 (US), and 2684 (G). DOMINICA: *Imray* (G); *Hodge* 1627 (G). MARTINIQUE: *Duss* 1425 (NY, US); *Stehlé* 6031 (G). ST. VINCENT: *Smith* 1249 (G, NY). TRINIDAD: *Sieber* 121 (G, NY); *Broadway* 5547 and 9845 (G); *Fairchild* 2863 (G).

North of our area the species is known from the Virgins, Porto Rico, Haiti and Cuba. Although reported from Jamaica it is almost certainly not native there. The West Indian material of *C. alliodora* has its twigs much less deformed by ant-domatia than that of Central America and northwestern South America. The older writers identified the plant with *C. Gerascanthus*, but that is a very different species native to Cuba, Jamaica, and adjoining Central America. For an excellent very detailed account of our tree see R. C. Marshall, *Silviculture of trees of Trinidad and Tobago*, pp. 167–172 (1939). He reports the plant from Tobago as well as from Trinidad.

3. *Cordia grandiflora* (Desv.) HBK. Nov. Gen. et Sp. 3: 77 (1818); Johnston, Jour. Arnold Arb. 16: 32 (1935).

Varronia grandiflora Desv. Jour. de Bot. 1: 273 (1809).—Type from Venezuela.

Ranging from British Guiana to central Venezuela and southward into the Amazon Basin; Trinidad.

TRINIDAD: Caparo, June 1918, *Broadway* (T); "Trinidad," Aug. 1928, *Abrahams, Herb. Trin.* 12215 (T).

According to Williams & Williams, *Useful and Ornamental Pl. Trinidad*, ed. 3, p. 112 (1941), the plant is frequently found in peasant gardens in southern Trinidad.

4. *Cordia globosa* (Jacq.) HBK. Nov. Gen. et Sp. 3: 76 (1818).

Varronia globosa Jacq. Enum. 14 (1760) and Sel. Stirp. 41 (1763).—In Caribaeorum maritimis.

Varronia dasycephala Desv. Jour. de Bot. 1: 274 (1808).—Habitat in Cumana, Antigua, arenosis humidis.

Cordia dasycephala (Desv.) HBK. Nov. Gen. et Sp. 3: 76 (1818).

Cordia sphaerocephala Humb. ex R. & S. Syst. 4: 801 (1820).—In arenosis Cumanae.

Varronia sphaerocephala Willd. ex HBK. Nov. Gen. et Sp. 3: 453 (1820).

Cordia bullata, var. *angustata* DC. Prodr. 9: 496 (1845).—Type from Guadeloupe.

Ranging south through the Lesser Antilles into South America.

ST. BARTHÉLEMY: *Questel* 578 (US). ST. KITTS: *Britton & Cowell* 257 (US); *Rose, Fitch & Russell* 3240 (US). ANTIGUA: *Box* 1160 (US); *Rose, Fitch & Russell* 3330 (G, US). MONTSEERAT: *Shafer* 232 and 510 (US). GUADELOUPE: *Duss* 2575 (G, US); *Stehlé* 2681 (G). DOMINICA: *Hodge* 2769 and 3861 (G). MARTINIQUE: *Duss* 652 (US).

The species as here accepted includes plants from the Lesser Antilles, Trinidad, Venezuela, and eastern Brazil. Related plants of the Greater Antilles, Mexico, and Central America are separated as *C. globosa* var. *humilis* (Jacq.) Johnston, Jour. Arnold Arb. 30: 98 (1949). They are distinguished by their leaves, which not only average much smaller than in typical *C. globosa*, but also have the marginal teeth and apex obtuse rather than acute. Also related to *C. globosa* are *C. caput-medusae* Taub., a very glandular plant of Brazil, and *C. subtruncata*, a Colombian plant with pallid strigose herbage. There are some other closely related but separable plants in Colombia and Venezuela, but these are as yet unnamed.

No type of *Varronia globosa* is preserved. It is necessary to interpret the species entirely from Jacquin's short diagnosis and vague remarks. They are as follows: "VARRONIA (*globosa*) spicis globosis, aequalibus. Frutex hic perfecte congruit cum *Varronia martinicensis*. Discrimen solum est in constanti globositate spicarum, in corollarum laciniis emarginatis ipsis, & in stigmatibus obtuso quadruplici. Habitat in Caribaeorum maritimis." Curiously, there is no mention of the setaceous calyx-lobes, probably the most distinctive feature of our species, cf. Johnston, Jour. Arnold Arb. 30: 102 (1949). Jacquin's statement that his *V. globosa* agrees closely with *V. martinicensis*, except as to inflorescence and floral structures, offers the most help in placing it. The foliage of typical *C. globosa*, as I have delimited it, agrees well in size, shape, and dentation with that shown in Jacquin's illustration of the type of *V. martinicensis*. Since *V. globosa* is given by Jacquin as Caribbean (i.e., West Indian and not continental), it very likely came from the Lesser Antilles, where he did much collecting and could have compared growing plants with *C. martinicensis*.

5. *Cordia salvifolia* Juss. ex Poir. Encyc. 7: 46 (1806). — Source of type not given.

Endemic to the Lesser Antilles.

BARBUDA: *Box* 613 (US). ANTIGUA: *Box* 1034 (US); *Rose, Fitch & Russell* 3339 (G, US). MONTSEERAT: *Shafer* 495 (US). GUADELOUPE: *Duss* 3959 (US); *Stehlé* 2025 (US), 2689 (G), 2698 (G), 6161 (G). MARIE GALANTE: *Stehlé* 165 (US), 2678 (G). DÉsirADE: *Stehlé & Quentin* 5340 (US). MARTINIQUE: *Duss* 287 (US). ST. LUCIA: *Beard* 1080 (G).

A very distinct member of the section *Varronia* which is endemic to our area. It is readily distinguished from all immediate relatives by its large, loose, repeatedly forked cymes. Many of the specimens have parasitized fruit, which eventually contains smooth ellipsoidal pupae suggestive of seeds. Normal fruit, however, has the irregular tuberculate single-seeded stone characteristic of all *Varronias*.

6. *Cordia polycephala* (Lam.) Johnston, Jour. Arnold Arb. 16: 33 (1935).

Varronia polycephala Lam. Tab. Encyc. 1: 418 (1791); Poir. Encyc. 4: 263 (1798).—Type from "America."

Varronia paniculata Wikström [Öfv. Guadeloupe. Fl.], K. Vet. Akad. Handl. 1827¹: 59 (1828).—Type from Guadeloupe, Forsström.

Cordia Wickstroemii Steud. Nom. ed. 2, 1: 419 (1841).—Based on *Varronia paniculata* Wikst. not *Cordia paniculata* Roth.

Cordia Wikstromii Steud. ex DC. Prodr. 9: 495 (1845).

Cordia sulfurata Krause, Beih. Centralb. 32²: 341 (1914).—Type from St. Vincent, Krause 11821.

Cordia ulmifolia, var. *ovata* DC. Prodr. 9: 495 (1845).—Type West Indian.

Cordia ulmifolia, var. *ovalis* DC. Prodr. 9: 495 (1845).—Type West Indian.

Ranging from the southern parts of the Dominican Republic south through Porto Rico, the Virgins and Lesser Antilles into northern South America.

ST. BARTHÉLEMY: *Stehlé* 7076 (G). ST. KITTS: *Britton & Cowell* 203 (NY). GUADELOUPE: *Stehlé* 3 (NY), 1100 (US), 2614 (US), 2680 (G), 2695 (G); *Duss* 2576 (G, NY, US). DOMINICA: *Cooper* 22 and 141 (G, NY, US); *Lloyd* 420 and 688 (NY); *Hodge* 792 (US), 793 (NY, US), 1451 (G), 2217 (G), 2319 (G), 2905 (G), 3900 (G). MARTINIQUE: *Hahn* 873 (G, US); *Duss* 1421 (G, NY, US); *Stehlé* 3646 (G). ST. VINCENT: *Eggers* 6551 (G); *Smith* 781 (G); *Beard* 1347 (G). GRENADA: *Broadway* (G, US, NY).

The name *C. polycephala* is here restricted to the more southerly and easterly of the two West Indian species formerly included in the aggregate of tropical American shrubs assembled under the names "*C. corymbosa*" or "*C. ulmifolia*." It ranges from the Dominican Republic south through our area into northern South America. On the southern continent it is most abundant in Venezuela, but it also occurs west to northern Colombia and in Brazil at least as far south as Ceará. The species is reported from Trinidad, but I have seen no material from the island and doubt that it is native there. It has recently been reported from St. Lucia, *Stehlé*, Carib. Forester 8: 106 (1947).

The former aggregate species of which *C. polycephala*, *sensu stricto*, is a small part, breaks up into two well-marked groups distinguishable by differences in inflorescence. In one the cymes are chiefly axillary, only the first produced by the shoot being terminal. In the other the cymes are all terminal, but, with the elongation of the shoot, come to be borne on stem internodes without any subtending leaf. *Cordia polycephala*, as here narrowly delimited, has an axillary inflorescence as does also *C. lineata* (L.) Don and *C. patens* HBK. These three segregates of the old complex may be at times difficult to distinguish in Venezuela but elsewhere are recognizable at a glance. They have very different patterns of geographical distribution. *Cordia polycephala* extends north via the Lesser Antilles to

Hispaniola. *Cordia lineata* appears in the northern and western parts of Hispaniola and extends to Cuba, Jamaica, Central America, and, apparently, Venezuela, cf. Johnston, Jour. Arnold Arb. 30: 92 (1949). *Cordia patens*, in contrast, is a shrub of the Amazonian headwaters and extends from the Guianas to eastern Peru.

The segregates of the old complex having extra-axillary inflorescences have their center of distribution south of the Equator. *Cordia bifurcata* R. & S. ranges from Costa Rica and Colombia south along the Andes into Argentina, cf. Johnston, Jour. Arnold Arb. 30: 90 (1949). *Cordia bolivi-ana* Gandoger is Bolivian. *Cordia urticifolia* Cham. is a coarsely strigose representative of the group in Brazil and Paraguay. Another member is *C. discolor* Cham. of Brazil. Of all these southern representatives only *C. discolor* shows instability as to type of inflorescence. It is the only one of the southern group which now and again makes embarrassing approaches towards *C. polycephala*.

The first name given to our plant appears to be *Varronia polycephala* Lam., which was described as follows: "1887, *Varronia polycephala*. V. foliis ovato-lanceolatis, serrati; pedunculis lateralibus; spicis globosis. Ex America. h Pluk. t. 328 f. 5? Il varie à pédoncules rameaux." The brief description certainly applies to some member of the former aggregate of which our plant is a part. Poiret, Encyc. 4: 263 (1797), so accepted it and so have all subsequent authors. I am assuming that Lamarck's type came from the French West Indies. If investigations at Paris prove this to be incorrect, then the next available name for our species is *C. Wickstroemii* Steud.

A few comments should be made regarding the name *Varronia monosperma* Jacq. Pl. Rar. Hort. Schoenbr. 1: 18, t. 39 (1797). The material upon which that species is described is said to have come from Caracas, Venezuela, a locality at which *C. polycephala* has been repeatedly collected. Jacquin's beautiful and very detailed plant of *V. monosperma* is unlike any plant I have seen from Central America, the West Indies, or northern South America. In fact it seems to represent the Brazilian and Paraguayan plant described as *C. urticifolia* Cham. (1829). The illustration shows very clearly the extra-axillary, internodal or oppositiflorous inflorescences that characterize the relatives of true *C. polycephala* south of the Equator. Jacquin's name is, in fact, the oldest name applied to that group. It has exact synonyms in *C. monosperma* (Jacq.) R. & S., 1819, *Varronia corymbosa* Desv. Jour. de Bot. 1: 275 (1809), and *Cordia corymbosa* (Desv.) Don, 1838.

7. *Cordia Schomburgkii* DC. Prodr. 9: 490 (1845); Johnston, Jour. Arnold Arb. 16: 39 (1935). — Type from British Guiana.

Cordia tobagensis Urban in Fedde, Repert. 16: 39 (1919). — Type from Tobago, Broadway 3072.

Cordia tobagensis, var. *Broadwayi* Urban in Fedde, Repert. 16: 40 (1919). — Type from Tobago, Broadway 4235.

Known only from the Guianas and from Tobago.

TOBAGO: Denmet Estate, *Broadway* 4235 (G, pt. of TYPE); Forest Reserve beyond Caledonia, *Broadway* 3072 (G, pt. of TYPE); Menna Road near Mason Hall, low shrub, fl. white, June 6, 1925, *Williams, Herb. Trin.* 11140 (T); Mt. St. George-Castara road, Oct. 18, 1937, *Cheesman, Herb. Trin.* 13208 (T).

8. *Cordia martinicensis* (Jacq.) R. & S. Syst. 4: 461 (1819).

Varronia martinicensis Jacq. Enum. 14 (1760) and Sel. Stirp. 41, t. 32 (1763).—Type from Martinique.

Known only from Dominica, Martinique and St. Lucia.

DOMINICA: *Hodge* 2543 and 2663 (G). MARTINIQUE: *Duss* 1423 (G, US); *Hahn* 286 (G, US); *Sieber* 60 (G); *Bailey* 252 (US); *Stehlé* 1040 (G, US), 2128 (NY), 3470 (G), 3642 (G), and 6925 (G). ST. LUCIA: *Beard* 1011 (G).

9. *Cordia curassavica* (Jacq.) R. & S. Syst. 4: 460 (1819); Johnston, Jour. Arnold Arb. 30: 99 (1949).

Varronia curassavica Jacq. Enum. 14 (1760) and Sel. Stirp. 40 (1760).—Type from Curaçao.

Varronia macrostachya Jacq. Enum. 14 (1760) and Sel. Stirp. 41 (1763).—Type from Cartagena, Colombia.

Cordia macrostachya (Jacq.) R. & S. Syst. 4: 461 (1819); Johnston, Jour. Arnold Arb. 16: 36 (1935).

Varronia guianensis Desv. Jour. de Bot. 1: 270 (1809).—Type from French Guiana.

Cordia canescens HBK. Nov. Gen. et Sp. 3: 73 (1818).—Type from Ibaque, Colombia.

Cordia graveolens HBK. Nov. Gen. et Sp. 3: 74 (1818).—Type from between Ferreras and Angostura, Venezuela.

Cordia cylindrostachya, var. *graveolens* (HBK.) Griseb. Fl. Brit. W. I. 480 (1861).

Cordia spicata Willd. ex R. & S. Syst. 4: 799 (1819).—Type from Angostura, Venezuela.

Cordia rugosa Willd. ex R. & S. Syst. 4: 801 (1819).—Type South American.

Cordia interrupta DC. Prodr. 9: 491 (1845).—Type from French Guiana.

Cordia cylindrostachya, var. *interrupta* (DC) Griseb. Fl. Brit. W. I. 480 (1861).

Cordia oxyphylla DC. Prodr. 9: 492 (1845).—Type from British Guiana.

Lithocardium cylindrostachyum, var. *platyphyllum* Kuntze, Rev. Gen. 2: 438 (1891).—Type from Trinidad.

Cordia chepensis Pittier, Contr. U. S. Nat. Herb. 18: 253 (1917).—Type from Panama.

Cordia littoralis Pittier, Contr. U. S. Nat. Herb. 18: 253 (1917).—Type from Costa Rica.

Ranging in northern South America (French Guiana to Colombia) and north into Central America and the Lesser Antilles.

MARTINIQUE: *Duss* 289 (NY). ST. VINCENT: *Smith* 470 (G, NY). GRENADA: *Eggers* 6139 (G); *Broadway* 141 (G, NY). BARBADOS: *Dash* 14 (NY). TOBAGO: *Eggers* 5458 (G); *Elmore* (G); *Broadway* 4254 (G,

NY). TRINIDAD: *Johnston 78* (G); *Broadway 11* (G); *Britton & Hazen 18* (G); *Riley 68* (NY).

The plant has sharp-pointed, lanceolate or lance-ovate leaves which are green and usually glabrous above. The upper leaf-surface may be smooth but commonly is more or less roughened by minute siliceous tuberculations present there in varying abundance and development. Occasionally the tuberculations become conic or even prolonged into short stiff bristle-tips. The surface of the leaf, however, is never soft hairy nor more or less velvety. The xerophytic form of the species has thickish lanceolate leaves 1.5–4 cm. broad, roughened on the upper face by an abundance of tuberculations. It is the form represented by the type of *Varronia curassavica*. In more sheltered places and especially those with much rainfall, the plants produce larger, proportionately broader and thinner leaves, 4–9 cm. wide, on which the upper surface is nearly bare or has tuberculations much reduced in size and number. Its spikes also tend to become very elongate. This is the form described as *Varronia macrostachya* Jacq. An extreme phase of this broad-leaved form was described from Trinidad as *Lithocardium cylindrostachyum*, var. *platyphyllum* Kuntze. For our purposes it may be called *Cordia curassavica*, var. *platyphylla* (Kuntze), comb. nov. As the name for the mesophytic phases with broad leaves it is applicable in our region only to plants collected on Trinidad and Tobago.

The present species, though not distinguished from *C. cylindrostachya* by many West Indian botanists, is readily separable from that more southerly ranging South American species by its complete lack of axillary spikes. True *C. curassavica* is very different in appearance and readily separable at a glance from the various closely related but as yet imperfectly defined species that occur north of it in the Greater Antilles and in Mexico. These latter are excluded from *C. curassavica* as here accepted. Our species is a natural and practicable one that occurs in northern South America from the Guianas to Colombia and extends north into Central America and the Lesser Antilles. A complete listing of its synonyms has been given above.

10. *Cordia divaricata* HBK. Nov. Gen. et Sp. 3: 74 (1818); R. & S. Syst. 4: 802 (1819); Johnston, Jour. Arnold Arb. 30: 101 (1949).
— Type from Cumana, Venezuela.

Cordia cuneiformis DC. Prodr. 9: 492 (1845).— Type from Caracas, Venezuela.

Northern Venezuela and adjacent Colombia, Curaçao, Martinique, Dominica.

DOMINICA: *Hodge 3808* (G); *Lloyd 839* (US). MARTINIQUE: *Duss 288* and *289* (NY); *Stehlé 3471* (G).

A relative of *C. curassavica* distinguishable by its usually smaller, generally more or less oblanceolate or obovate leaves, usually soft hairy on the upper surface. Its calyx tends to have lobes less sharply triangular and proportionately broader than in its relative.

11. *Cordia dentata* Poir. Encyc. 7: 48 (1806); Johnston, Jour. Arnold Arb. 21: 347 (1940). — Type from Curaçao.

"*Cordia alba*" of most authors.

West Indies, Mexico, Central America, and northern South America; frequently cultivated.

ST. BARTHÉLEMY: *Questel* 682 (US). GUADELOUPE: *Duss* 2757 (US); *Questel* 824 (US); *Stehlé* 950 (US), 2691 (G), 2843 (G). MARTINIQUE: *Duss* 285 (US). ANTIGUA: *Box* 1188 (G, US). BARBADOS: *Waby* 68 (US); *Warming* 98 (US). TOBAGO: *Broadway* (G). TRINIDAD: Chacachacare Isl., *Finlay, Herb. Trin.* 1842 (T).

Readily recognized because of its toothed, slenderly petiolate leaves, broad funnellform shallowly lobed white corollas, ribbed calyx, and large watery white fruits. In West Indian botany the plant is well known under the name *Cordia alba* or *Calyptrocordia alba*, names unhappily not properly applicable to it.

12. *Cordia obliqua* Willd. Phytogr. 4, t. 4 (1794) and Sp. Pl. 1: 1072 (1797). — Type from western India.

Cordia tremula Griseb. Fl. Brit. W. I. 479 (1861). — Type from Barbados, Lane.

An Indian tree introduced into the West Indies, where it is now widely distributed.

ST. KITTS: *Fairchild* 2635 (G, US); *Britton & Cowell* 135 (NY). ANTIGUA: *Box* 1428 (US); *Rose, Fitch & Russell* 3370 (US). MONTERRAT: *Shafer* 124 and 209 (NY, US). GUADELOUPE: *Hahn* 953 (US); *Stehlé* 260 (US), 2683 (G). MARIE GALANTE: *Stehlé* 195 (US). ST. VINCENT: *Smith* 462 (G). GRENADA: *Beard* 34 (G); *Broadway* 1810 (G, US). BARBADOS: *Bovell* 466 (NY); *Gooding* (G); *Eggers* 7179 (G, US).

For the most of a century this tree has been known in the West Indies as *C. tremula* Griseb. and accepted as a native species, endemic to the Lesser Antilles. It is, however, a native of India and was introduced into the West Indies, probably during the eighteenth century, and most likely at Barbados. Mr. E. G. B. Gooding (in lit., June 1942) has some significant observations concerning the plant on Barbados. He notes that the species is absent from the few remnants of original forest on the island. It grows "wild" only on open waste land, seldom far from habitations, and is frequently cultivated. This ability to go wild is also demonstrated in Cuba. The trees in the Botanic Garden at Soledad, originating from Lesser Antillean seed, now have progeny in waste land outside the garden.

The name *Cordia obliqua* Willd. here applied to our plant is subject to future revision, although it certainly belongs to the particular form of the Indian plant represented in the Caribbean area. Unfortunately, it is only one of a confusing complex of many closely related forms represented in the tropics of Asia and Malaysia. Until the complex is thoroughly studied and a modern classification of it available, names applied to its forms can be only tentative. Nevertheless I am inclined to believe that the name selected may stand. The Indian tree, along with its other relatives in

southeastern Asia and the South Pacific, are readily distinguishable by form of style from the African and Levantine *C. Myxa* L., with which they were formerly associated. For the eastern complex there is only one name older than *C. obliqua* Willd. (1794), namely *C. dichotoma* Forst. (1786). This latter was applied to a plant of the wetter tropics and is distinguishable from *C. obliqua* by its thinner elliptic leaves and smaller flowers. The eventual monographer of the group will, I am confident, distinguish these two extreme forms, if not as species, then certainly as varieties.

13. *Cordia tetrandra* Aublet, Hist. Pl. Guian. 1: 222, t. 87 (1775); Johnston, Jour. Arnold Arb. 16: 11 (1935).—Type from French Guiana.

Widely distributed at low altitudes in tropical South America, but not common.

BARBADOS: Dodd's, St. Philip, 1902, *Bovell* 437 (NY).

The specimen cited is probably from a cultivated tree. The species, however, has such a hit-and-miss distribution over so wide an area in tropical South America that its natural occurrence a little further north, as a rare tree in the southern West Indies, would not be surprising.

14. *Cordia Collococca* [Sandmark] L. Amoen. Acad. 5: 377 (1759), as "*C. Callococca*."—Type from Jamaica.

Cordia Collococca L. Sp. Pl. ed. 2, 274 (1762), excluding "*Cordia glabra* Sp. Pl. sp. 1 p. 191."

Cordia Callococca L. Syst. ed. 12, 176 (1767), excluding phrase "fol. cordato-ovatis."

Cordia micranthus Sw. Prodr. 47 (1788) and Fl. Ind. Occ. 1: 460 (1797).—Type Jamaican.

Cordia ehretioides Lam. Tab. Encyc. 1: 421 (1791); Urban, Symb. Ant. 8: 576 (1921).—Type from Santo Domingo.

Cordia Collococca, var. *ehretioides* (Lam.) Poir. Encyc. 7: 42 (1806).

Cordia glabra of authors, not Linnaeus, cf. Johnston, Jour. Arnold Arb. 21: 345 (1940).

Cuba and Mexico south to northern South America.

GUADELOUPE: *Duss* 2577 (NY); *Stehlé* 91 (NY), 66 (NY), 2682 (G).

DOMINICA: *Hodge* 3890 (G). MARTINIQUE: *Duss* 282 (NY). ST. VINCENT: *Smith* 1546 (NY), 1836 (G, NY). GRENADA: *Broadway* (G, NY).

BARBADOS: *Gooding* 609 (NY). TOBAGO: *Montserin*, Herb. Trin. 13647 (T).

TRINIDAD: *Britton*, *Freeman & Watts* 2692 (G).

The plant is deciduous and develops its inflorescences late in the dry season on leafless or nearly leafless twigs, at least before the new growth of leaves is expanded. In having precocious inflorescences and bright red fruit it is readily separable from all other congeners in our area. In addition to those islands from which specimens are cited, the species is also reported from St. Barthélemy, Antigua, Bequia, and Mustique. A good account of the tree, with interesting field observations, has been published by R. C. Marshall, *Silviculture of trees of Trinidad and Tobago*, pp. 172–3 (1939).

The name of this well-marked species merits a few words of discussion. The first name applied to it was *Cordia Callococca* [Sandmark] Linnaeus (1759). It is one of the many binomials applied by Sandmark to Jamaican species described and named under polynomials in Browne's History of Jamaica. In the present instance Sandmark's page-reference to the History of Jamaica is incorrect, being "166" and not 167. In such a very abbreviated synopsis as that published by Sandmark this error might be very confusing indeed. However, a perusal of his dissertation makes it obvious that he intended his binomial, *C. Callococca*, to apply to the first of the two species of trees for which Browne had erected the genus *Collococca*. Sandmark's specific epithet was derived from Browne's generic name. The latter was given in allusion to the glutinous pulp in the fruit of the plant, a meaning lost by the vowel change in the specific epithet as published by Sandmark. This vowel change, I believe, is another example of typographical or clerical error in the dissertation. This is consistent with the fact that when Linnaeus, adopting the binomial proposed by his student, first treated the species in his own publications, he used the original Brownean spelling in the specific name. This he maintained in the third edition of the Species Plantarum, 274 (1764). Only in the last of his major works, Syst. ed. 12, 176 (1769), is the specific epithet *Callococca* used. Subsequent authors have spelled the name both ways. I have adopted "*Collococca*" as the correct spelling for the species, since I believe "*Callococca*" originated in error. The epithet has usually been capitalized and treated as a generic noun in apposition. As such, it is meaningless unless it conforms to the original Brownean spelling.

Though there may be some doubt as to the correct spelling of Sandmark's binomial, its correct application seems clear. The Jamaican tree discussed by Browne, History 167 (1756), as "*Collococcus*. 1. *Foliis rugosis venosis oblongo-ovatis, floribus laxe racemosis*," is evidently the same as the plant now under discussion.

In the past Sandmark's publication (Dec. 1759) has been overlooked, and the name *Cordia Collococca* has been accepted as established in the second edition of the Species Plantarum (1762). This publication of 1762 also has its complications. As has been discussed elsewhere, Jour. Arnold Arb. 21: 345 (1940), by some error the name *Cordia glabra* L., Sp. Pl. 191 (1753), was listed as a synonym of *Cordia Collococca* rather than under *Ehretia Bourreria* L., where it properly belongs. With this incorrect synonym excluded, *Cordia Collococca* L. (1762) is based partially on the reference to Browne's History already used by Sandmark and partially on a reference to Sloane's great book on Jamaica, 2: 95, t. 203, f. 2 (1725). Sloane gives a good illustration and discussion of our plant.

15. *Cordia bicolor* A. DC. Prodr. 9: 485 (1845); Johnston, Jour. Arnold Arb. 16: 23 (1935) and 21: 349 (1940). — Type from Dutch Guiana.

Lithocardium Lockartii Kuntze, Rev. Gen. 2: 438 (1891). — Type from Trinidad, Lockart.

Cordia Lockartii Kuntze, Rev. Gen. 2: 438 (1891), in synonymy.

Northern South America and northward in Central America; Trinidad.

ST. VINCENT: *Anderson* (Kew). TRINIDAD: *Britton & Broadway* 2797 (G); *Britton* 2500 (G, NY); *Britton & Hazen* 1926 (G, NY); *Britton* 549 (G, NY); *Eggers* 1431 (Kew); *Eggers* 1178B (Berlin); *Lockart* (Kew, TYPE).

The specimens cited from St. Vincent probably came from a cultivated tree. Alexander Anderson was director of the botanical garden on St. Vincent from 1785 to 1811. I doubt if *C. bicolor* occurs naturally in the West Indies north of Trinidad. Some excellent field observations concerning the Trinidad tree are given (sub "*Cordia Lockhartii*") by R. C. Marshall, *Silviculture of trees of Trinidad and Tobago*, pp. 173-4 (1939). Marshall states that the ripe fruit is a greenish yellow drupe, ovoid-rounded, 12 mm. long, and covered with minute hairs. Its stone is said to be 10 mm. long, pointed at the apex, and irregularly furrowed.

16. *Cordia elliptica* Sw. Prodr. 47 (1788) and Fl. Ind. Occ. 1: 461 (1797); Urban, Symb. Ant. 3: 357 (1903). — Type from "Jamaica."

Cordia reticulata Vahl, Ecol. 3: 5 (1807). — Type from Montserrat, *Ryan*.

Cordia laevigata of authors.

A species endemic to the Lesser Antilles.

MONTSERRAT: *Shafer* 345 (NY). GUADELOUPE: *Fairchild* (G); *Duss* 2584; *Stehlé* 2679, 2692, 2693, and 2844 (G). DOMINICA: *Cooper* 58 and 142 (G, NY); *Beard* 1464 (G); *Lloyd* 244 (NY); *Hodge* 1126, 1809, 2093, 2247, 2349, 2612, 3012, 3359, and 3458 (G). MARTINIQUE: *Duss* 242 (NY), 1422 (G, NY). ST. LUCIA: *Beard* 495 (G).

I am following Urban in identifying our present plant with *C. elliptica* Sw. The specimen from the Swartz herbarium at Stockholm that appears to be the type of *C. elliptica* is labeled as from "Jamaica." It has an old inflorescence with some persisting, apparently blighted calyces. There are no corollas nor fruit. The indument on the inflorescence and calyces is sparse, but if these are persisting old ones found on a tree out of flower, that is not surprising. Although our species does have a dense strigose indument on new flowering inflorescences, the hairy covering thins out considerably on old inflorescences and even on fruit-bearing calyces. The herbage and stems of the Swartz type are indistinguishable from those of the plant of the Lesser Antilles. The type agrees well with plants from our area but is very different and readily separable from all members of its genus known from Jamaica. I am willing to believe that the type of *C. reticulata* was attributed to Jamaica through some error. It was more likely collected on Dominica, probably by Ponthieu.

The name *Cordia laevigata* Lam. Encyc. 1: 422 (1791); Poir. Encyc. 7: 46 (1806), has been applied to our plant. Judging from the original descriptions, however, Lamarck's plant must be very different from *C. elliptica*, particularly as to flowers. Indeed, it appears to be the same as the more northern *C. nitida* Vahl (1793), and being older, probably should be taken up in place of the latter.

Among West Indian species our plant is notable for its firm, glabrous, lustrous, strongly acuminate leaves, its elongate flower-buds that are clothed with abundant short appressed sericeous hairs, and its large glabrous drupe containing an obliquely ascending apically pointed stone. It is a very distinct species, perhaps most closely allied to plants of Venezuela and Colombia. Its drupe must be very large and conspicuous, but little has been recorded by collectors or authors concerning the color, size, configuration, and other features in the fresh state.

17. *Cordia sulcata* DC. Prodr. 9: 488 (1845). — Type from Guadeloupe, Bertero.

Ranging from the Barbados and St. Vincent north to Cuba.

SABA: *Boldingh* 1477 and 1495 (NY). ST. KITTS: *Britton & Cowell* 302 (NY). ANTIGUA: *Box* 1491 (US). MONTSERRAT: *Shafer* 475 (NY, US); *Ma'oney* 420 (G). GUADELOUPE: *Bertero* (G, photo of TYPE); *Duss* 3079 and 3773 (NY, US); *Stehlé* 295 (US), 1078 (US), 1831 (US), 2220 (US), 2677 (G). DOMINICA: *Imray* (G); *Beard* 661 (G); *Narodny* 1 (G); *Eggers* 829 (G); *Hodge* 3154 and 3745 (G). MARTINIQUE: *Duss* 1426 (NY, US), 4502 (NY), 4703 (G, NY, US); *Hahn* 752 (NY); *Stehlé* 4468 (US). ST. VINCENT: *Smith* 771 (G, NY). BARBADOS: *Eggers* 7294 (G, US).

This is a species endemic to the West Indies which is found in the Lesser Antilles and in all the Greater Antilles except Jamaica. Its closest relative is *C. macrophylla* L., an endemic of Jamaica, which differs only in having much larger, more elongate leaves, and a shaggy-velvety indument on twigs, petioles, and inflorescences. The only other close relative of *C. sulcata* is *C. panamensis* of Trinidad, Tobago, and Central America. This latter differs in its bristly twigs, very scabrous upper leaf-surface, and non-cordate leaf-bases. These three species, *C. sulcata*, *C. macrophylla*, and *C. panamensis*, are immediately related and are distinguishable by neither flowers nor fruit. They have, however, distinct geographic ranges and are separable by vegetative characters. Though not "strong" species, they are useful units worthy of continued recognition.

The type of *C. sulcata* DC. is an immature specimen with new, partially expanded foliage and flower-buds. It was collected on Guadeloupe by Bertero. In addition to the islands from which I have cited specimens, the species is reported from St. Eustatius and St. Lucia.

18. *Cordia panamensis* Riley, Kew Bull. 1927: 125 (1927); Johnston, Jour. Arnold Arb. 21: 347 (1940). — Type from Panama.

Known only from Central America, Trinidad and Tobago.

TRINIDAD: Southern Watershed Reserve, *Marshall, Herb. Trin.* 12433 (T); Southern Watershed Reserve, main ridge, tree 25 ft. tall, *Marshall, Herb. Trin.* 12410 (T); S. W. Reserve, *Russell, Herb. Trin.* 12262 (T); Quinam Road, Southern Range, small tree, *Williams, Herb. Trin.* 12186 (T); Maracas Bay, *Dannouse, Herb. Trin.* 6749 (T); Maracas, *Herb. Trin.* 1843 (T); Arima, *Dannouse, Herb. Trin.* 8986 (T); St. Patrick, *Dardaine, Herb. Trin.* 11588 (T); Monos, *Herb. Trin.* 1845 (T); Botanic Garden near

Carpenter Shop, *Broadway, Herb. Trin.* 3833 (T); Botanic Garden, *Herb. Trin.* 1050 and 5942 (T). TOBAGO: tree 40 ft. in woods, 800 ft. alt., *Eggers* 5590 (G).

In the past this tree of Trinidad and Tobago usually has been identified as "*Cordia sulcata*." I am unable to distinguish it from *C. panamensis*, a species previously recognized only in Central America. No species native to northern South America is readily confused with it. The relations of the plant are with *Cordia sulcata* DC., which ranges in the West Indies from Barbados to Cuba. Among its distinctive features are its bristly twigs and inflorescence and its harsh, very scabrous upper leaf-surfaces. Excellent field observations concerning the tree in Trinidad are given (sub *Cordia sulcata*) by R. C. Marshall, *Silviculture of trees in Trinidad and Tobago*, pp. 174-5 (1939). He reports the ripe fruit as a round, whitish, translucent drupe that is smooth, about 1 cm. in diameter, and very suggestive of a rather large English white currant. It contains a hard, woody, irregularly shaped stone, about 6 mm. in diameter, embedded in mucilaginous pulp.

19. *Cordia sericicalyx* A. DC. *Prodr.* 9: 485 (1845); Johnston, *Jour. Arnold Arb.* 16: 25 (1935).—Type from British Guiana.

Cordia ierensis Britton, *Bull. Torr. Bot. Club* 50: 54 (1923).—Type from Morne Bleu, Trinidad, *Britton, Freeman & Bailey* 2277.

Ranging from Dutch Guiana to western Colombia and north into Trinidad.

TRINIDAD: Morne Bleu, tree 10 m. tall, *Britton, Freeman & Bailey* 2277 (NY, TYPE; G, T); Mount Tocuche, tree 15 m., corolla white, *Britton, Hazen & Mendelson* 1344 (G, NY); Blanchisseuse Road near 9-mile post, small tree, *Broadway* 6000 (G); St. Anne, *Herb. Trin.* 1848 (T); Maracas, *Herb. Trin.* 588 (T); Maraval, *Herb. Trin.* 4533 (T); Arima-Blanchisseuse road, 14th-15th mile, *Marshall, Herb. Trin.* 12882 (T); Tucuche, *Britton & Freeman, Herb. Trin.* 9094 (T); Tucuche, *Williams, Herb. Trin.* 11016 (T).

This species commonly has relatively thin, rather smooth, parchment-like leaves that are usually markedly heteromorphic. The leaf-surfaces, twigs, and inflorescences are very finely and minutely short-strigose. The indument, though readily detected with a hand lens, is inconspicuous. At a casual glance the mature twigs and leaves might pass as glabrous. Some field observations concerning this species (sub *Cordia ierensis*) are given by R. C. Marshall, *Silviculture of trees of Trinidad and Tobago*, p. 175 (1939). Marshall states that the drupe is green, about 1 cm. long, and contains an irregular stone embedded in a mucilaginous pulp.

2. ROCHEFORTIA

KEY TO THE SPECIES

- Twigs very thorny; flowers nearly sessile, borne one or two together directly on axillary short-shoots.....1. *R. acanthophora*.
Twigs with few or no thorns; flowers borne several to many in a distinctly pedunculate cyme.....2. *R. cuneata*.

1. *Rochefortia acanthophora* (DC.) Griseb. Fl. Br. W. I. 482 (1861).
Ehretia acanthophora DC. Prodr. 9: 510 (1845).—Type from Santo Domingo.
 ANTIGUA: *Box* 858 (G).
 The species is reported from St. Martin and St. Eustatius.
2. *Rochefortia cuneata* Sw. Prodr. 54 (1788) and Fl. Ind. Occ. 1: 552 (1897).—Type from Jamaica.
 GUADELOUPE: *Duss* 2753 (G).
 The species is also reported from Dominica and Martinique.

3. BOURRERIA

Bourreria succulenta Jacq. Enum. 14 (1760) and Sel. Stirp. 44 (1763).
 —Type from Curaçao.

Bourreria recurva Miers, Contr. 2: 234 (1869).—Type from Dominica.

Ranging from Florida to Venezuela and Panama, generally distributed in the West Indies.

ANGUILLA: *Boldingh* 3518 (NY). ST. MARTIN: *Boldingh* 2805 (NY). ST. BARTHÉLEMY: *Forsström* (NY); *Questel* 90 (NY). ST. KITTS: *Britton & Cowell* 366 (NY). MONTSERRAT: *Shafer* 310 and 497 (NY). GUADELOUPE: *Duss* 2752 (G, NY). MARIE GALANTE: *Stehlé* 2837 (G). DOMINICA: *Fishlock* 53 (NY); *Lloyd* 616, 661, and 664 (NY). MARTINIQUE: *Stehlé* 6051 (G); *Hahn* 920 and 1095 (G); *Bailey* 203 (G). ST. VINCENT: *Smith* 551 (G, NY) and 569 (G). GRENADA: *Broadway* (G). TOBAGO: *Broadway* 9166 (G); *Eggers* 5517 (G); *Williams, Herb. Trin.* 11444 (T). TRINIDAD: *Maraval, Baptiste, Herb. Trin.* 5860 (T).

Schulz in his monograph of the genus, Urban Symb. Ant. 7: 58 (1911), reports collections from St. Eustatius, Antigua, St. Lucia, Bequia, and Mustique.

The name of the present genus has variant spellings in "*Bourreria*," "*Beurreria*," and "*Beureria*." The first, however, is correct. The name was proposed and first applied to our genus by Patrick Browne, Nat. Hist. Jamaica 168 (1756), who spelled it "*Bourreria*." This spelling was adopted by Jacquin, Enum. 2 and 14 (1760), who was the first author to use the concept and name in a publication employing binomial nomenclature. This act established the correct orthography. To be sure Jacquin, Sel. Stirp. 44 (1763), later adopted the spelling "*Beurreria*," and subsequent authors, notably O. E. Schulz, the spelling "*Beureria*," but these are not corrections of error but expressions of personal taste, and are not sanctioned by rules of nomenclature. Cf. Kew Bull. 1935: 385 (1935).
 BOURRERIA CUMANENSIS (Loefl.) O. E. Schulz.

A form of this species was described as *Crematomia Guildingiana* Miers, Contr. 2: 246, t. 87 (1869), and given as having been collected on St. Vincent by Guilding. If the plant is not mislabeled it almost certainly represents, not a wild, but a cultivated plant, probably one from the botanic garden that flourished on St. Vincent early in the nineteenth century. The

species is known with certainty only from the dry north coast of Colombia and Venezuela, and though it might be expected on some of the small dry islands near Trinidad, it is certainly not to be expected on St. Vincent.

4. TOURNEFORTIA

KEY TO THE SPECIES

- Leaves linear-spathulate, broadest below the apex and gradually contracted towards the attachment, 3-10 cm. long, silvery silky from an abundance of appressed hairs; fruit with a very thin flesh, having a basal central cavity, very tardily breaking up into a pair of two-seeded nutlets; strand plant.....1. *T. gnaphalodes*.
- Leaves with a distinct blade and petiole; fruit with a very fleshy mesocarp, with a lobed or unlobed stone not hollow at the base.
- Fruit with a conspicuously 2-4-lobed stone; embryo curved; corolla-lobes subulate or cuneate, greenish or yellowish; style elongate, falling with the corolla.
- Corolla-tube 3-8 mm. long, with a moderately expanded throat, lobes not more than half the length of the tube, cuneate; ripe fruit orange or yellow; leaves nearly glabrous....2. *T. maculata*.
- Corolla-tube 1.5-3 mm. long, constricted at summit, lobes subulate, nearly as long as tube; ripe fruit usually white.
- Leaves 4-10 cm. broad, 8-18 cm. long, leathery; inflorescence narrow, stiff, the branches short, densely flowered and divaricate, borne on an elongate axis...3. *T. subsessilis*.
- Leaves 0.5-4(-6) cm. broad, 3-10(-12) cm. long, firm but not leathery; inflorescence loosely branched..4. *T. volubilis*.
- Fruit with ovoid stone, at most merely sulcate on the sides; embryo straight; corolla-lobes elliptic to triangular-ovate, white; ripe fruit white.
- Style elongate, 1-3 mm. long, usually falling with corolla; leaves very large, usually 15-40 cm. long, and having 11-15 pairs of major veins; tree, up to 9 m. tall.....5. *T. filiflora*.
- Style very short, sessile and persistent on the mature fruit; leaves 5-20 cm. long, with 4-9 pairs of veins; plant usually scandent or climbing.
- Foliage and twigs glabrous or practically so; calyx-lobes 1-2 mm. long.....6. *T. bicolor*.
- Foliage and twigs evidently hairy.
- Calyx-lobes lanceolate, 2-4 mm. long; stems bearing short curved grayish hairs about 1 mm. long; corolla-tube 4-5 mm. long.....7. *T. hirsutissima*.
- Calyx-lobes subulate, 5-9 mm. long, slender and long-attenuate; stems shaggy, bearing abundant slender brown hairs 2-4 mm. long; corolla-tube 5-8 mm. long.....8. *T. cuspidata*.

1. *Tournefortia gnaphalodes* (L.) R. Br. ex R. & S. Syst. 4: 538 (1819).
Heliotropium gnaphalodes L. Syst. ed. 10, 913 (1759); Amoen. Acad. 5: 376 and 394 (1759). — Type West Indian.

Mallotonia gnaphalodes (L.) Britton, Ann. Missouri Bot. Gard. 2: 47 (1915).

Messerschmidia gnaphalodes (L.) Johnston, Jour. Arnold Arb. 16: 165 (1935).

A strand plant widely distributed in the West Indies.

GUADELOUPE: *Stehlé* 2687 and 2842 (G). MARTINIQUE: *Duss* 246 (G). MUSTIQUE: *Smith* G26 (G).

In addition to the islands mentioned above it has been reported in the Lesser Antilles from Anguilla, St. Martin, St. Barthélemy, Saba, St. Eustatius, Antigua, St. Vincent, Bequia, Carriacou, and Barbados. It is not reported from Trinidad nor Tobago, but is well known to the westward on the islands off the Venezuela coast. Guppy, Plants, Seeds and Currents, p. 247 (1917), has given observations regarding the behavior of the fruits of *T. gnaphalodes* and its modes of distribution in the West Indian drift.

Considering the present status of classification in the subfamily *Heliotropioideae* it has seemed best to assign this species to *Tournefortia*. Traditionally in this subfamily those species with dry fruits have been placed in *Heliotropium* and those with a fleshy mesocarp in *Tournefortia*. There are reasons for believing that this may not be a natural division. However, until the subfamily is thoroughly studied and a convincingly natural new classification has been worked out, it seems best to continue the separation of *Tournefortia* and *Heliotropium* in the traditional manner. To assign the present species to the monotypic *Mallotonia* or to group it with two Old World species in *Messerschmidia* is inconsistent when other equally distinct groups of species are still submerged in the older traditional genus.

This West Indian species has a fleshy mesocarp, although a very scanty one that soon dries. Otherwise the fruit is very similar to that found in certain groups of *Heliotropium*. Its only distinctive feature is the presence of corky tissue, a feature which I emphasized in assigning the plant to *Messerschmidia*. This, incidentally, has its weakest development in our West Indian plant.

2. *Tournefortia maculata* Jacq. Enum. 14 (1760) and Sel. Stirp. 47 (1763).—Type from Cartagena, Colombia.

Tournefortia syringaefolia Vahl, Symb. 3: 23 (1794); Johnston, Jour. Arnold Arb. 16: 48 (1935).—Type from French Guiana.

Tournefortia peruviana Poir. Encyc. Suppl. 4: 425 (1816); Urban, Symb. Ant. 8: 586 (1921).—Type from Peru.

Tournefortia Sagraeana DC. Prodr. 9: 522 (1845).—Type from Cuba.

Tournefortia guadelupensis Urban, in Fedde Repert. 17: 169 (1921).—Type from Guadeloupe, *Duss* 3992.

Ranging from Cuba and southern Mexico south through the West Indies and Central America into northern and western South America.

GUADELOUPE: *Duss* 3992 (G). DOMINICA: *Hodge* 2385 (G). TOBAGO: *Broadway* 4606 (G). TRINIDAD: *Broadway* 6389 (G).

The long-neglected name *T. maculata* Jacq. is evidently the oldest and proper name for this widely distributed plant. Jacquin (1763) described

fruiting specimens from Cartagena, Colombia, as follows: "TOURNEFORTIA (*maculata*) foliis ovatis, utrinque glabris; spicis ramosissimis, pendulis. Frutex ramis debilibus; foliis integerrimis, acuminatis, petiolatis, inodoris; fructibus luteis basi quatuor maculis subrotundis atrisque notatis. Habitat Carthagenae in arbustis & sepibus." The glabrous leaves and the yellow drupes splotted with black are distinctive features of the present plant.

In the West Indies and Central America *T. maculata* presents problems in delimitation only in Jamaica, Haiti, and Porto Rico. Plants from these islands, described as *T. laurifolia* Vent. and *T. jamaicensis* Urban, differ from ordinary *T. maculata* in their larger, long-attenuate calyx- and corolla-lobes. In Jamaica and Haiti plants with short or elongate lobes both occur, but in Porto Rico only the latter. The plants with elongate attenuate lobes seem to deserve some nomenclatural recognition, but only field work will determine whether this should be as species, variety, or form.

3. *Tournefortia subsessilis* Cham. Linnaea 8: 119 (1833); Johnston, Contr. Gray Herb. 92: 85 (1920).—Type from Brazil.

Known only from eastern Brazil and Trinidad.

TRINIDAD: Balandra Bay, June 21, 1921, *Freeman, Herb. Trin. 10431* (T); Balandra Bay, Dec. 8, 1933, shrub near sea, corolla reddish, *Broadway 9331* (G); road near sea between Balandra and Toco, fl. yellow, fruit drupaceous, lobed, apparently ripening white, Aug. 20, 1940, *Cheesman & Baker 370, Herb. Trin. 13735* (T).

I am unable to distinguish the above cited collections from the plant of eastern Brazil (Bahia) known as *T. subsessilis*. The plant, though related to *T. volubilis*, has a more compact, more elongate, and less branched inflorescence that is made up of short, much more densely flowered scorpioid cymes. Furthermore, its leaves are also very much larger. Indeed, in general appearance the leaves are most suggestive of those of *T. bicolor*. The blade is ovate to elliptic, 4–10 cm. broad, 8–18 cm. long, somewhat leathery in texture, lustrous and practically glabrous above, and dull and glabrescent beneath. Balandra Bay is on the Atlantic coast of Trinidad about 10 miles from the northeast corner of the island. It lies about 2000 miles from the Brazilian localities at which the species has been previously known. No plant readily confused with it is known north of the Amazon.

4. *Tournefortia volubilis* L. Sp. Pl. 140 (1753).—Type West Indian.

Tournefortia sericea Vahl, Ecol. 1: 17 (1796).—Type from Montserrat, Ryan.

Messerschmidia punctata Spreng. Neue Entdeck. 3: 28 (1822).—Type from Martinique, Sieber.

Tournefortia punctata Spreng. Syst. 1: 643 (1825).

Tournefortia psilostachya, var. *caribaea* DC. Prodr. 9: 525 (1845).—

Based on material from Guadeloupe, Martinique, and Trinidad.

Tournefortia caribaea (DC.) Griseb. Fl. Brit. W. I. 484 (1861).

Tournefortia barbadensis N. E. Brown ex Britton, Bull. Torr. Bot. Club 48: 343 (1922).— Type from Barbados, *Bovell & Freeman* 404.

Tournefortia trinitatis Riley, Kew Bull. 1925: 139 (1925).— Type from Trinidad, *Riley* 210.

An extremely variable species ranging from Florida and Mexico south through the West Indies and Central America into South America.

MONTERRAT: *Ryan* (G, photo of TYPE). GUADELOUPE: *Stehlé* 2685, 2686, 2832, and 2841 (G). MARIE GALANTE: *Stehlé* 2836 (G). DOMINICA: *Hodge* 2533, 2542, 3083, 3084, and 3152 (G); *Eggers* 689 (G); *Imray* (G). MARTINIQUE: *Duss* 4504 (G); *Hahn* 415 (G); *Sieber* 63 (G). GRENADA: *Broadway* (G). ST. VINCENT: *Eggers* 6600 (G); *Smith* 127, 1277, and 1540 (G). BARBADOS: *Eggers* 7097 (G). TOBAGO: *Broadway* 3665 (G); *Eggers* 5914 (G). TRINIDAD: *Chacachacare, Herb. Trin.* 1858 (T); *Patos Island, Broadway* 8908 (G); *Gaspree Island, Britton* 451 and 2781 (G); *St. Anne, Broadway, Herb. Trin.* 9203 (T).

In one form or another this extremely variable species is to be expected on all the islands in our area. In addition to islands from which specimens are cited above, it has been reported from St. Martin, St. Barthélemy, Saba, St. Eustatius, Desirade, St. Lucia, Bequia, and Mustique. The species is the most variable member of its genus. Its leaves vary greatly in size and shape as well as in quality, quantity, distribution and color of pubescence. Forms of the plant may differ conspicuously in gross appearance. With so many diverse phases it is not surprising that the species has accumulated the most extensive synonymy in the genus. Above I have given only those names that are based on plants originating in our area. These apply to phases of the plant that are neither unusual in appearance nor endemic to our region. As with most of the phases named in other regions, the named ones from the West Indies can be expected to appear here and there erratically at widely separated places within the total geographical range of the species.

5. *Tournefortia filiflora* Griseb. Fl. Brit. W. I. 483 (1861); Urban, Symb. Ant. 4: 522 (1910).— Type from Dominica, *Imray*.

Ranging from Porto Rico south to St. Vincent.

GUADELOUPE: *Stehlé* 2697 and 2839 (G). MARIE GALANTE: *Stehlé* 2838 (G). DOMINICA: *Hodge* 1592 (G); *Imray* 322 (G). ST. VINCENT: *Smith* 1542 (G).

As originally published *T. filiflora* included not only our present plant but also material of another species from Jamaica. I am following Urban, l. c., who limited the species to the plant distributed from Porto Rico to St. Vincent. With the type to be selected from among the non-Jamaican specimens cited by Grisebach, the best choice is *Imray's* collection from Dominica. The plant grows in Porto Rico and the Virgins and is reported from St. Martin, Saba, St. Eustatius, St. Kitts, and St. Lucia. It replaces *T. foetidissima* L. in the West Indies south of Hispaniola. The various reports of the latter species in the Lesser Antilles probably all apply to *T. filiflora*.

6. *Tournefortia bicolor* Sw. Prodr. 40 (1788) and Fl. Ind. Occ. 1: 344 (1797). — Type from Jamaica.

Tournefortia laevigata Lam. Tab. Encyc. 1: 416 (1791); Poir Encyc. 5: 356 (1804). — Type from Guadeloupe, *Badier*.

Widely distributed in the American tropics.

GAUDELOUPE: *Stehlé* 710, 2831, and 2835 (G), *Duss* 2579 (G). MARIE GALANTE: *Stehlé* 2694 and 2834 (G). DOMINICA: *Cooper* 195 (G); *Eggers* 688 (G); *Hodge* 132, 2126, 2347, 3165, 3176, 3262, 3721, and 3756 (G). MARTINIQUE: *Hahn* 719 (G); *Duss* 4503 (G). ST. VINCENT: *Smith* 434 (G). GRENADA: *Alexander*, *Herb. Trin.* 434 (T). TRINIDAD: *Broadway* 9104 and 9844 (G); *Britton* 2206 (G); *Britton & Hazen* 409 (G).

The plant occurs on most of the islands in our area. Besides those from which specimens are cited, it has been reported from Saba, St. Kitts, Antigua, Montserrat, Barbados, and Tobago.

7. *Tournefortia hirsutissima* L. Sp. Pl. 140 (1753). — Type from Haiti. Widely distributed in tropical America.

GAUDELOUPE: *Stehlé* 2840 (G). MARTINIQUE: *Duss* 1207 (G). TOBAGO: *Eggers* 5609 (G); *Williams* 11113 (G). TRINIDAD: *Broadway* (G); *Johnston* 79 (G).

This species appears to have a limited distribution in our area. I have seen specimens from only a very few islands and have found reports from only two additional ones, St. Martin and St. Vincent.

The original description of *T. hirsutissima* L. was based upon a drawing made by Plumier, which Linnaeus studied in Holland previous to the publication of the *Species Plantarum*. The drawing was no doubt that subsequently published by Burman, *Pl. Am. Plumier* 226, *t.* 229 (1760). Notes associated with Plumier's original drawings at Paris indicate that the plant concerned was collected near Léogane, Haiti.

8. *Tournefortia cuspidata* HBK. Nov. Gen. et Sp. 3: 83 (1818); Johnston, *Jour. Arnold Arb.* 16: 54 (1936). — Type from Ecuador?

Tournefortia obscura DC. Prodr. 9: 517 (1845). — Type from British Guiana.

Tournefortia setifera Urban & Ekman, *Arkiv Bot.* 22A: no. 17: 94 (1930). — Type from Haiti, *Ekman H10204*.

Tropical South America, southern Central America, Trinidad, and Haiti.

TRINIDAD: Cedros at St. Anna, low cliff, seashore, *Broadway*, *Herb. Trin.* 9407 (T); Irois forest, *Williams*, *Herb. Trin.* 12046 (T); Cap de Cille, shrub in roadside bush, *Baker*, *Herb. Trin.* 14205 (T).

5. HELIOTROPIUM

KEY TO THE SPECIES

- Flowers scattered along the elongate leafy stems; fruiting pedicels elongate, 2–10 mm. long; fruit conic above the middle.....1. *H. lagoense*.
Flowers aggregated into crowded unilateral spikes; fruiting pedicels stout, 0–1 mm. long; fruit rounded or depressed at summit.

Plant completely glabrous, very succulent, usually somewhat glaucous. .
2. *H. curassavicum*.

Plant hairy; herbage not decidedly succulent, never with a pallid waxy bloom.

Petiole short, 1-4 mm. long; spike bearing scattered small bracts; fruit dividing into 4 similar single-seeded nutlets, strigose.

Leaf-blade 2-5 mm. long; plant a low much-branched perennial, usually densely strigose and silvery-silky; style very short and obscure.....3. *H. microphyllum*.

Leaf-blade 10-30 mm. long; plant laxly branched, erect.

Plant perennial, shrubby, 3-15 dm. tall; leaf-blade abruptly contracted into a petiole 1-2 mm. long, style elongate, evident.....4. *H. ternatum*.

Plant annual, 1-3 dm. tall; leaf-blade very gradually contracted into a petiole 2-4 mm. long; style very short and obscure.....5. *H. filiforme*.

Petiole well developed, evident, 5 mm. long or longer; spikes without bracts among the flowers; plants usually annual.

Corolla usually blue or violet, the tube 2-4.5 mm. long and much exserted from the calyx; fruit glabrous, ribbed, angulate, cleft vertically, the two lobes divergent and each breaking up into a pair of single-seeded nutlets. . . .

.....6. *H. indicum*.

Corolla white, tube short, scarcely if at all surpassing the small calyx; fruit not cleft.

Fruit breaking up into 4 single-seeded nutlets, strigose; spikes commonly paired and usually 2-5 cm. long; plant usually densely strigose and cinereous.....

.....7. *H. procumbens*.

Fruit breaking in half, the halves each 2-seeded, epidermis roughened by minute bladder-like swellings that collapse and appear scale-like in age; spikes commonly single and usually becoming 10 cm. long; plant sparingly appressed hairy, green. .8. *H. angiospermum*.

1. *Heliotropium lagoense* (Warm.) Gürke in Engler & Prantl, Nat. Pflanzenf. iv. Abt. 3a: 97 (1893).

Schlcidenia lagoensis Warming, Kjoeb. Vidensk. Meddel, 1867: 15 (1868).

— Type from Brazil.

Heliotropium trinitense Urban, Symb. Ant. 7: 350 (1912). — Type from Piarco Savanna, Trinidad, Lunt 6030.

Known from Brazil, eastern Bolivia, Surinam, Venezuela, Panama, Costa Rica, Guatemala, and Trinidad.

TRINIDAD: Piarco Savanna, Lunt 6030 (Berlin, TYPE; fragment, G); Piarco Savanna, 1895, Lunt, *Herb. Trin.* 6030 (T); Piarco, airfield, plant decumbent, fl. white with yellow tube and eye, March 1939, *Cheesman, Herb. Trin.* 13375 (T).

A broadly distributed species known only from a relatively few widely scattered localities. Its wiry, slender, ascendingly branched stems are laxly decumbent or prostrate, usually spring from a clearly annual root,

and usually become 1–2 dm. long. It is a plant of damp soil and has been collected most frequently where savanna conditions prevail.

2. *Heliotropium curassavicum* L. Sp. Pl. 130 (1753).—Type from Curaçao.

Widely distributed in the warmer parts of America, growing along coasts and in saline soils inland.

ST. MARTIN: *Walsh* (NY). ST. BARTHÉLEMY: *Forsström* (NY). GUADELOUPE: *Duchassaing* (G); *Stehlé* 707 and 2833 (G); *Duss* 2755 (G, NY). MARTINIQUE: *Duss* 1416 (NY); *Egler* 394 (NY). ST. VINCENT: *Smith* 1213 (G). UNION: *Smith* D34 (NY). GRENADA: *Broadway* (NY). BARBADOS: *Dash* 353 (NY).

This halophyte is to be expected on all the Lesser Antilles. In addition to the stations given above, the plant is reported from St. Eustatius, Antigua, Marie Galante, Bequia, and Mustique. Surprisingly, there are no reports of its occurrence on either Trinidad or Tobago.

3. *Heliotropium microphyllum* Sw. ex Wikström [Ofv. Guadeloupe. Fl.] K. Vet. Akad. Handl. 1827¹: 58 (1828).—Type from Guadeloupe, *Forsström*.

A variable species ranging north through the Virgins, Porto Rico, Hispaniola, and Cuba into the Bahamas.

ANGUILLA: *Boldingh* 3517 (NY). ST. MARTIN: *Boldingh* 3034 (NY). GUADELOUPE: coralline rocks along coast, alt. 30 m., Point des Châteaux, *Stehlé* 2696 (G).

The species is here interpreted in the broadest sense and includes the habitually similar plants found in the Greater Antilles and the Bahamas. The plants are moderately variable but hardly to the degree that would justify the many segregate species that have been proposed. From Haiti the plant has been described as *H. plumerii* Urban, *H. elegans* Urban, and *H. glomerifolium* Urban, and from Porto Rico as *H. crispiflorum* Urban. Even more names have been applied to plants of Cuba and the Bahamas.

4. *Heliotropium ternatum* Vahl, Symb. Bot. 3: 21 (1794).—Type from the West Indies.

Pioctonon ternatum (Vahl) Raf. Sylva Tellur. 88 (1838).

Tournefortia humilis L. Sp. Pl. 141 (1753); Syst. ed. 10, 917 (1759); Sp. Pl. ed. 2, 202 (1762).—Based on a plant of Martinique illustrated by Plumier.

Heliotropium humile (L.) R. Br. ex R. & S. Syst. 4: 37 (1819), not Lam. (1791).

Heliotropium hirtum Lehm. Neue Schr. Naturf. Ges. Halle 3²: 10 (1817), Nov. Acta Acad. Caes. Leop. Nat. Cur. 9: 135 (1818), and Asperif. 1: 62 (1818); R. & S. Syst. 4: 38 (1819).—Type from Venezuela.

Heliotropium hispidum HBK. Nov. Gen. et Sp. 3: 87 (1817) and 451 (1820).—Type from Venezuela.

Heliotropium fruticosum, var. *hispidum* (HBK.) DC. Prodr. 9: 543 (1845).

Schleidenia hispida (HBK.) Fresen. in Mart. Fl. Bras. 8¹: 37 (1857).

Heliotropium demissum R. & S. Syst. 4: 37 and 733 (1819), in pt. — Type West Indian; a mixture of *H. ternatum* and *H. fruticosum*.

Poetonon antillanum Raf. Sylva Tellur. 88 (1838), in pt. — Type West Indian; a mixture of *H. ternatum* and *H. fruticosum*.

Heliotropium fruticosum, var. *confertum* DC. Prodr. 9: 542 (1845). — Type from Guadeloupe, Bertero.

Heliotropium fruticosum, var. *angustilobum* DC. Prodr. 9: 543 (1845). — Type from Cuba.

Native to the West Indies, Yucatan, and northern Venezuela and Colombia.

ANTIGUA: Box 1291 (G); Rose, Fitch & Russell 3360 (NY). MONT-SERRAT: Shafer 412 (NY). DESIRADE: Stehlé 288 (NY), 2829 (G); Duss 2756 (NY). DOMINICA: Imray (G); Bailey 750 (NY); Lloyd 827 (NY); Hodge 3790 (G). MARTINIQUE: Sieber, Fl. Mixta 430 (G, NY); Duss 1417 (G, NY), Egler 39-6 and 39-53 (NY); Hahn 416 (G); Stehlé 2215 (NY), 3469 (G), 6168 (G). ST. VINCENT: Smith 977 (G, NY).

A loosely branched shrubby plant frequently forming a bush 3-20 dm. tall. I have seen one collection from Cuba (Wright 3135) and numerous collections from the Bahamas, Jamaica, Porto Rico, and the Virgins. The species has been reported from Haiti, Guadeloupe, St. Lucia, and Bequia. It is apparently absent from Trinidad and Tobago, but is common along northern Venezuela and on the adjacent Margaritas and Dutch islands.

Distinctive of the species is its bushy growth and strong root and its development of opposite or ternate leaves at one or more nodes on vigorous shoots. It varies considerably in size and shape of leaves, in pubescence, and in quantity of opposite or ternate leaves developed. In the West Indies it has been confused with the very different *H. fruticosum* L., cf. Johnston, Contr. Gray Herb. 81: 66 (1928). That species occurs in Porto Rico, Haiti, and Jamaica, and on the continent, and is readily distinguished from our plant by having a lower habit, annual root, and well-developed leaf-like bracts in the inflorescence. In an earlier paper I failed to distinguish *H. ternatum* from the related South American *H. Ottoni* Lehm. That latter species has synonyms in *H. strictum* HBK., *Tournefortia monostachya* Willd., *H. Ottonianum* R. & S., *H. Ottonis* DC., *H. strictissima* Moric., and *Schleidenia subracemosa* Warm. It differs from our species in its short-lived chiefly annual root, few usually sparingly branched and frequently strict stems, uniformly alternate leaves, and more southerly range. The plant has been found from northern Venezuela to eastern Brazil. Though formerly confused with *H. salicoides* Cham., both *H. Ottoni* and *H. ternatum* are readily distinguished by their white rather than decidedly yellow corollas, cf. Johnston, Jour. Arnold Arb. 16: 62 (1935). In Central America *H. ternatum* is confined to the Yucatan peninsula, being replaced in Mexico and other parts of northern Central America by the closely related but lower-growing and less strongly perennial *H. oaxacana* DC. and *H. mexicanum* Greenm. These two latter species have only alternate leaves. The more northerly ranging *H. mexicana* occurs from Oaxaca to Sonora and Nuevo Leon and has retrorse

hairs on its leafy twigs, as well as leaves that are usually broadest at or above the middle.

For the present species Urban, *Symb. Ant.* 8: 590 (1921), has used the name "*H. humile* (L.) R. Br. *Prodr.* I (1810) p. 497 (non Lam.)." The name is based upon *Tournefortia humilis* L., which has its ultimate basis in a plant illustrated by Plumier. It is known that Linnaeus, while in Holland, studied copies of Plumier's plates during the preparation of the *Species Plantarum*. Among these was the representation of the present species later published by Burnam, *Pl. Amer. Plumier.* 224, *t.* 227, *f.* 2 (1760). Notes accompanying the original drawing at Paris state that the plant concerned was collected on Martinique (south end) in the area known as "La pointe des Salines au Cul de Sac Marin." It is a very coarse atypical form of *H. ternatum*. Urban indicates that Robert Brown made the combination "*H. humile*." This is incorrect. The actual transfer was first published by Roemer & Schultes, *Syst.* 4: 37 (1819), and even then only as a synonym. This binomial, in any case, is not a valid name for our plant, since it is a late homonym of *H. humile* Lam. *Tab. Encyc.* 1: 393 (1791). The application of Lamarck's binomial has been uncertain. I have referred it to the synonymy of *H. angiospermum* Murr.

5. *Heliotropium filiforme* Lehm. *Götting. Gel. Anzeigen* 1817: 1515 (1817), and *Asperif.* 1: 37 (1818); Johnston, *Contr. Gray Herb.* 81: 61 (1928) and *Jour. Arnold Arb.* 16: 62 (1935).—Type from Venezuela.

Paraguay and eastern Bolivia northward through Brazil to the Guianas and Venezuela; northern Central America and adjacent Mexico; Trinidad.

TRINIDAD: Icacos, *Broadway* 7401 (T).

This is a plant of wet ground. It has been collected most commonly near streams.

6. *Heliotropium indicum* L. *Sp. Pl.* 130 (1753).

A weedy plant widely distributed in the warmer parts of the world.

ANTIGUA: *Box* 929 (G). MONTserrat: *Shafer* 366 (NY). DOMINICA: *Lloyd* 247 (NY); *Hodge* 3872 (G). MARTINIQUE: *Duss* 1419 (G, NY). ST. LUCIA: *Walsh* (NY). ST. VINCENT: *Smith* 1213 (G). BEQUIA: *Joseph* 231 (NY). GRENADA: *Broadway* (G, NY). BARBADOS: *Freeman* 12H (NY). TRINIDAD: *Herb. Trin.*

Reported from most of the islands in our area and very probably present on all of them.

7. *Heliotropium procumbens* Miller, *Dict. ed.* 8, no. 10 (1768); Johnston, *Contr. Gray Herb.* 81: 52 (1928).—Type from Cartagena, Colombia.

Heliotropium inundatum Sw. *Prodr.* 40 (1788) and *Fl. Ind. Occ.* 1: 343 (1797).—Type from Jamaica.

A species widely distributed in the warmer parts of America but of restricted occurrence in the West Indies.

ANTIGUA: *Box* 852 and 1357 (G). TRINIDAD: *Broadway* (G, NY); *Britton* 2506 (G, NY), *Britton & Hazen* 720 (NY).

The plant has been found in Jamaica, Cuba, Hispaniola, and Porto Rico, but is very rare or absent in the Lesser Antilles. It has been reported from Guadeloupe, but recent collectors have not found it there, and Duss, Fl. 452-3 (1897), does not list it for the French islands. The plant is usually annual and usually favors places subject to periodic inundations of fresh water.

8. *Heliotropium angiospermum* Murray, Prodr. Stirp. Göttingen 217 (1770); Johnston, Contr. Gray Herb. 81: 10 (1928).—Type from a European botanic garden.

Schobera angiospermum Murray ex Scopoli, Intr. 158 (1777); Britton & Wils., Bot. Porto Rico 6: 134 (1925).

Heliotropium parviflorum L. Mant. 2: 210 (1771).

Heliotropium humile Lam. Tab. Encyc. 1: 393 (1791); Johnston, Jour. Arnold Arb. 16: 186 (1935).

Widely distributed in the warmer parts of America.

ST. MARTIN: *Boldingh* 2344 (NY). ST. BARTHÉLEMY: *Forsström* (NY). ST. EUSTATIUS: *Walsh* (NY). ST. KITTS: *Kidder* (G); *Britton & Cowell* 279 (NY). ANTIGUA: *Duss* 41 (NY); *Box* 1050 (G). GUADELOUPE: *Stehlé* 762 (NY), 2688 (G), 2830 (G); *Duchassaing* (G, NY). MARTINIQUE: *Stehlé* 3641 (G); *Duss* 1418 (G, NY); *Hahn* (G); *Egler* 39-45 (NY). ST. VINCENT: *Smith* 1582 (NY). GRENADA: *Broadway* (NY). TOBAGO: *Williams* (T). TRINIDAD: *Broadway* 2717 and 5140 (G).

A plant of sunny open places with well-drained soil. Frequently a weed in waste ground. The species has been reported from Anguilla, Saba, Dominica, and Barbados.

The name *H. humile* Lam. has long been of uncertain application and a source of confusion, cf. R. & S. Syst. 4: 38, 733 and 734 (1819) and Johnston, Contr. Gray Herb. 81: 67 (1928). It has been applied to such diverse species as *H. ternatum* Vahl, *H. fruticosum* L. and *H. angiospermum*. After a study of specimens available to Lamarck at Paris I am now of the opinion that *H. humile* Lam. belongs in the synonymy of *H. angiospermum*.

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PLANTAE PAPUANAE ARCHBOLDIANAE, XIX *

LILY M. PERRY

THIS PAPER covers the Cunoniaceae of Papuaia in the Arnold Arboretum herbarium. The following genera are represented: *Spiraeanthemum*, *Gillbeea*, *Opocunonia*, *Spiraeopsis*, *Ceratopetalum*, *Schizomeria*, *Aistopetalum*, *Weinmannia*, and *Pullea*. I have found nothing to match either *Kaernbachia* or *Stollaea*. The latter, from the description, appears exceedingly close to the genus *Opocunonia*, which Schlechter accepted as having fleshy fruit. In the abundant material of this genus at hand, it can now be shown that the fruit is capsular and very similar to that described for *Stollaea*. The fruit of *Aistopetalum*, however, is a drupe; there are, accordingly, two genera with drupaceous fruits represented in New Guinea. Some reductions have been made, others may need to be made. Wherever species have been added to a genus (except in *Weinmannia*), a brief key is given to help future workers evaluate the species. In *Weinmannia*, because of the interrelationships of the species, it would be necessary to prepare a key including the Malaysian and Polynesian species as well; we do not have sufficient material for such a key. The genus *Gillbeea* is represented by two collections (*Clemens* 3430, 3769) which practically match the figure of Schlechter's *G. papuana*. The other genera are elaborated below.

SPIRAEANTHEMUM A. Gray

KEY TO THE SPECIES

- Leaves denticulate, chartaceous.....*S. Kajeewskii*.
 Leaves entire or inconspicuously crenulate-serrulate, coriaceous (except in *S. parvifolium*).
 Pubescence of the branchlets, the under surface of the leaves, and the inflorescence dense and shaggy; calyx shortly villous or pilose.....*S. Pulleanum*.
 Pubescence of the branchlets and inflorescence shorter, usually \pm appressed; calyx glabrous.
 Leaves four in a verticil, cuspidate-acuminate; scales of the disk ovate.....*S. integrifolium*.
 Leaves opposite or ternate, not cuspidate-acuminate; scales of the disk oblong or quadrate, not ovate.
 Leaves small, $2-2.7 \times 1-1.7$ cm., chartaceous; carpels villous; styles subclavate.....*S. parvifolium*.
 Leaves larger, $5.5-13 \times 2.5-6$ cm., coriaceous; carpels puberulous or almost glabrous; styles subulate.
 Axis of the inflorescence hirtellous or subtomentose....
 *S. reticulatum*.

*Botanical Results of the Richard Archbold Expeditions. See Jour. Arnold Arb. 30: 39-63, 1949.

Axis of the inflorescence puberulous.

Leaves elliptic or lance-elliptic (broadest at the middle).

Mature leaves densely reticulate on both surfaces, margins remotely crenulate-serrulate; foli-
cles practically glabrous (here and there
are very scattered minute hairs).....
.....*S. novoguineense*.

Mature leaves obscurely reticulate on the upper
surface only, margins entire; foli-
cles sparsely but evenly puberulous.....
.....*S. idenburgense*.

Leaves lanceolate (broadest below the middle).....
.....*S. lanceolatum*.

***Spiraeanthemum Kajewskii* Perry, spec. nov.**

Arbor usque 20 m. alta; ramulis atro-fuscis, novellis minute pubescentibus, compressis, nodis paulo incrassatis, cito glabrat; stipulis oblongis, 9 mm. longis, 3 mm. latis, obtusis, extus appresse pubescentibus; foliis chartaceis, ellipticis, 5–12 cm. longis, 2.5–5 cm. latis, utrinque angustatis, apice acutiusculis vel breviter et obtuse acuminatis, basi cuneatis, margine denticulatis, supra olivaceis subtus pallidioribus, utrinque glabris (subtus costa venisque hinc inde pilis obsitis), venis primariis utrinsecus ± 13 oblique patentibus prope marginem furcatis utrinque perspicuis, venulis \pm dense reticulatis utrinque manifestis; petiolo 0.8–2 cm. longo; inflorescentiis ± 7.5 cm. longis, axi et ramulis puberulis, multifloris; pedicellis 1 mm. longis; calyce 1.5 mm. longo, lobis 4 vel 5, oblongis, 1 mm. longis, acutiusculis; staminibus longioribus 1 mm. alternis 0.7 mm. longis, antheris minutis; disci squamis 4 vel 5, bilobatis apice truncatis vel paulo retusis, 0.4 mm. longis, 0.5 mm. latis; carpellis 4 vel 5, ovariis 0.7 mm. longis, pubescentibus, 2-ovulatis, stylis 0.4–0.5 mm. longis, vix 0.2 mm. crassis, stigmatibus capitatis; folliculis 3.5 mm. longis, 0.7 mm. diam., appresse pubescentibus.

SOLOMON ISLANDS: Bougainville: Kupei Gold Field, *Kajewski 1700* (TYPE), April 1930, alt. 1000 m., rain-forest (tall tree up to 20 m. high); Koniguru, Buin, *Kajewski 2082*, Aug. 1930, alt. 950 m., rain-forest (tree up to 20 m. high; flowers white. Wood used by natives for building houses). Guadalcanal: Uulolo, Tutuve Mt., *Kajewski 2533*, April 1931, alt. 1200 m., rain forest (tree 8 or 9 m. high; flowers minute, green; fruits small, mostly in fours).

Kajewski 2082 is taken from new growth. It is much more pubescent than the type, the terminal bud is villous as well as two very young leaves subtending it. Also, the leaves are somewhat larger (10–15 \times 5.5–8.5 cm.) and the midrib and veins of both surfaces are pubescent with fine hairs, the lower surface more densely so. Between the veins the lamina is glabrate. Further, the axis and branches of the inflorescence are much more hairy than those of the type. These collections appear nevertheless to be conspecific.

Spiraeanthemum Kajewskii is more like some Polynesian species than those of New Guinea. It should be compared with *S. Macgillivrayi* Seem. from Aneityum, which is only very briefly characterized and of which we have no specimen. It suggests *S. samoense* A. Gray, but this last species has leaves rounded at the base, stamens as long as the calyx or longer, and the parts of the disk as many as the stamens.

Spiraeanthemum Pulleanum Schlechter in Bot. Jahrb. 52: 140. 1914, in Nova Guin. 12: 491, t. 191. 1917; Kaneh. & Hatus. in Bot. Mag. (Tokyo) 56: 111. 1942.

NETHERLANDS NEW GUINEA: 15 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 11923, Brass 12017, 12136*, Jan. 1939, alt. 1780 and 1800 m., common in mossy forest (subsidiary tree 15–18 m. high; flowers light yellow; leaves stiff, convex).

I am unable to distinguish these collections either from this species (as defined in the original description) or from Kanehira's collection taken in the type locality, except that the leaves are not, or are only very slightly, bullate. This characteristic appears to be variable within the species.

Spiraeanthemum reticulatum Schlechter in Bot. Jahrb. 52: 140. 1914.

NETHERLANDS NEW GUINEA: 18 km. southwest of Bernhard Camp, Idenburg River, *Brass 12693*, Feb. 1939, alt. 2150 m., mossy forest (tree attaining a height of 25 m. and stem diameter of 30 cm.).

This collection agrees fairly well with the original description except that it is difficult to decide what Schlechter considered a short petiole. In this specimen the largest leaf is 6.5 cm. long (including a petiole 1 cm.) and 3.2 cm. wide. The smaller leaves have petioles about 5 mm. long not including the shortly decurrent (1–3 mm.) base of the lamina. The lamina tends to be slightly convex between the impressed primary nerves, and the margins are somewhat revolute. The axis and branchlets of the inflorescence are more hirtellous or subtomentose than villous, the hairs are fairly short and crinkly but not matted. The carpels are mostly puberulous in this profusely fruiting specimen. The seeds are about 2.5 mm. long.

Spiraeanthemum idenburgense Perry, spec. nov.

Arbor 16 m. alta, 35 cm. diam.; ramulis atro-fuscis, novellis puberulis, nodis incrassatis; foliis coriaceis, oppositis et ternatis, ellipticis, (2.3–) 5.5–11 cm. longis, (1.5–) 2.5–6 cm. latis, utrinque angustatis, apice obtusis, basi cuneatis, margine integris, utrinque glabris, supra olivaceis, subtus pallidioribus, venis primariis utrinsecus 6–8 supra impressis subtus prominulis, oblique patentibus prope marginem arcuatis, venulis dense reticulatis supra vix distinctis, subtus perspicuis; petiolo (0.3–) 1–1.5 cm. longo; inflorescentiis 5.5–13 cm. longis, pedunculo 0.5–6 cm. longo, axi et ramulis puberulis; calyce 2 mm. longo, glabro, lobis 4 vel 5, ovatis subacutis, 1.3 mm. longis, 1 mm. latis; filamentis 1.2 mm. longis, antheris ellipsoideis, 0.4 mm. longis, leviter retusis; disci squamis oblongis vel quadratis 0.6 mm. longis; carpellis saepissime 3, ovariis pubescentibus,

0.7 mm. longis, 2-ovulatis; stylis 1.1 mm. longis; folliculis 5 mm. longis \pm puberulis; seminibus 2.3 mm. longis.

NETHERLANDS NEW GUINEA: 15 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 11938* (TYPE), Jan. 1939, alt. 1680 m., frequent on forested slopes (tree 16 m. high, 35 cm. diameter; flowers light yellow; fruit yellow-green).

This species shows much variability in the size of the leaves and the length of the infructescences. The mature leaves are more firmly coriaceous than in any other species at hand. When the leaves are ternate, often one leaflet is much smaller than the others.

***Spiraeanthemum novoguineense* Perry, spec. nov.**

Arbor \pm 15 m. alta, 20 cm. diam.; ramulis atro-cinereis, novellis puberulis, nodis incrassatis; foliis coriaceis oppositis, interdum ternatis, ellipticis utrinque angustatis, basi cuneatis, apice anguste obtusis vel subrotundatis, interdum breviter et obtuse acuminatis, margine remote crenulato-serrulatis vel integris, utrinque glabris dense reticulatis, venis primariis utrinsecus 5-7, patenti-ascendentibus prope marginem arcuatis, supra inconspicuis, subtus prominulis, lamina 2.5-8.5 cm. longa, 1.3-4.2 cm. lata, in petiolo 2-5 mm. decurrente; petiolo 3-10 mm. longo, supra \pm applanato, interdum puberulo; infructescentiis usque 9 cm. longis, axi et ramulis \pm puberulis; pedicellis vix 1.5 mm. longis; calyce vix 2 mm. longo, glabro, lobis 4, 1.3 mm. longis, 0.9-1 mm. latis, acutiusculis vel obtusiusculis; filamentis 1.7-2 mm. longis, glabris; disci squamis 0.5-0.6 mm. longis, 0.2 mm. latis, oblongis vel paulo cuneatis vel interdum subquadratis; carpellis 3 vel 4, immaturis 1.8 mm. longis, sparsim pilosulis 2- or 3-ovulatis, maturis 4 mm. longis, hinc inde pilis minutis obsitis; stylis subulatis 1.2 mm. longis; seminibus 2 mm. longis.

NETHERLANDS NEW GUINEA: 15 km. southwest of Bernhard Camp, Idenburg River, *Brass 11860* (TYPE), Jan. 1939, alt. 1800 m., mossy forest (abundant subsidiary tree \pm 15 m. high, 20 cm. diameter; fruits green).

NORTHEAST NEW GUINEA: vicinity of Samanzing, *Clemens 9476, 9584*, Jan., Feb. 1939, alt. \pm 2400 m.

In these collections the leaves are occasionally ternate. At a glance the reticulate upper surface of the leaf may be seen. The species differs from *S. parvifolium* Schltr. in having somewhat larger and flat coriaceous leaves. It may be distinguished from *S. reticulatum* Schltr. by the larger leaves, the shorter infructescence (not more than half as long again as the leaves), and the puberulous axis and branchlets. In *S. reticulatum* Schltr. the inflorescence is two or three times as long as the leaves, and the peduncle is villous.

***Spiraeanthemum lanceolatum* Perry, spec. nov.**

Arbor glabra; ramulis fuscis, nodis incrassatis, alabastris parvis, breviter tomentosis; foliis coriaceis, oppositis vel interdum ternatis, lanceolatis, 6.5-13 cm. longis, 2.4-4.8 cm. latis, basi cuneatis, apice late et obtuse acuminatis, acumine 6-12 mm. longo, margine integris, utrinque glabris,

venis primariis utrinsecus ± 7 , patenti-ascendentibus prope marginem arcuatis, supra impressis subtus prominulis, venulis dense reticulatis supra inconspicuis subtus perspicuis; petiolo (incl. lamina 3–7 mm. decurrente) 0.5–1.3 cm. longo, canaliculato; inflorescentiis 3–5 cm. longis, axi et ramulis puberulis; pedicellis 1–1.8 mm. longis; calyce 1.7 mm. longo, lobis 4–6, 1.2 mm. longis, 0.6–0.7 mm. latis, oblongis vel oblongo-ellipticis, acutiusculis; filamentis 1.5–2 mm. longis, antheris minutis, late ellipsoideis minute apiculatis; disci squamis 4–6, bilobis (interdum bipartitis), 0.2–0.3 mm. longis truncatis vel paulo retusis; carpellis 2–4, ovarii 0.5 mm. longis, sparsim pubescentibus, 4-ovulatis; stylis 1.5–2 mm. longis.

NETHERLANDS NEW GUINEA: 2 km. southwest of Bernhard Camp, Idenburg River, *Brass 13615* (TYPE), Mar. 1939, alt. 700 m., rain-forest (substage tree; flowers white).

This species is readily distinguished from *S. novoguineense* by the lanceolate entire leaves with a smooth upper surface. The latter character is also found in *S. idenburgense*, but the leaves of the latter are elliptic and somewhat more firmly coriaceous. *Spiraeanthemum idenburgense* also has a little larger flowers with shorter filaments and styles but larger disk scales than *S. lanceolatum*.

OPOCUNONIA Schlechter

In our material there are at least four species of this genus, and five different collections in fruit. The fruits are bivalvate capsules instead of drupes having a fleshy exocarp as indicated in the original description. The seeds are winged at both ends ± 3 mm. long (including the wings) and about 0.5 mm. broad. With only the original description of the genus *Stollaea* Schltr. and the figure of the type-species *S. papuana* Schltr. for comparison, I am unable to find any generic characters to separate that genus from *Opocunonia* Schltr. However, since we have no material which matches *S. papuana* Schltr., I merely mention this in passing, and leave the actual reduction to the monographer, who should have access to isotype material, if possible.

Opocunonia kaniensis Schlechter in Bot. Jahrb. 52: 160, fig. 8, A-G. 1914.

NETHERLANDS NEW GUINEA: Bele River, 18 km. northeast of Lake Habema, *Brass & Versteegh 11120*, *Brass 11478*, Nov. 1938, alt. ± 2200 and 2300 m., frequent in the forests (large canopy tree; bark reddish brown, warted; wood soft, flowers white); 6 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 12563*, Feb. 1939, alt. 1230 m., common in primary forest (tree 32 m. high, 59 cm. diam.; bark gray; sapwood orange, heartwood dark red; flowers white; fruits green).

NORTHEAST NEW GUINEA: Ogeram nang, *Clemens 5022*, Jan. 1937, alt. 1770 m.; Samanzing, *Clemens 8967*, 9297, Oct., Nov. 1938, alt. 1600–1800 m., mountain bush (tree 15 in. to 3 ft. diam.; flower buds pale green; flowers white); Matap, *Clemens 11102*, Feb. 1940, alt. 1500–1800 m.

In these specimens the base of the leaflets is often rounded, then very shortly cuneate; the ovary is puberulous rather than glabrous; the capsule is 6–8 mm. long and about 3 mm. diameter. The stipules vary in size (0.7–2.5 cm. long, 1–3 cm. broad) and are somewhat rectangular in outline, with truncate or broadly and shallowly retuse apex. The rounded sides contract into a broad short base at the attachment to the stem. From this base the two main veins extend to the outer points of the apex like a very broad V.

Opocunonia Nymanii (K. Sch.) Schlechter in Bot. Jahrb. 52: 159. 1914.

Ackama Nymanii K. Sch. in K. Schum. & Lauterb. Nachtr. Fl. Deutsch. Schutzgeb. Südsee, 272. 1905.

NORTHEAST NEW GUINEA: Morobe District, Sattelberg, *Clemens* 6654, June 1937.

This collection, although fragmentary and with only young flower-buds, matches very closely the original description. At hand is another specimen collected below Boana in Aug. 1938, at approximately 750 m. alt., *Clemens* 8704 (tall tree 2 ft. diam.); a few leaflets of this specimen are about the same size as those of *Clemens* 6654, but most of the leaflets are larger, the largest being 12.5 cm. long, 4 cm. broad and chartaceous; those of *Clemens* 6654 are slightly firmer. The branches of the inflorescence are villous, even in the infructescence, those of the other specimen (of which we have only a fragment of the inflorescence) are only minutely puberulous. *Clemens* 8704 has an inflorescence (young buds only) about 10 cm. long and an infructescence about the same length. The capsule (without the persistent style) is 5 mm. long and minutely appressed-pubescent.

Opocunonia papuana Kanehira & Hatusima in Bot. Mag. (Tokyo) 56: 108, fig. 4. 1942.

NETHERLANDS NEW GUINEA: Chaban, 30 km. inward from Nabire, *Kanehira & Hatusima* 11756, Feb. 1940, alt. 100 m., in dense rain-forest (tree 30 m. high); 15 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh* 11950, Jan. 1939, alt. 1900 m., occasional in primary forest (tree 31 m. high, 43 cm. diam.; bark black; sapwood red-yellow, heartwood dark red; flowers white); 18 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh* 12501, Feb. 1939, alt. about 2000 m., rare in primary forest (tree 43 m. high, 67 cm. diam.; bark black, rough; wood red-yellow; flowers white; ripe fruit brown); 6 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh* 12540, 13105, Feb. 1939, alt. 1200 m., frequent or occasional in primary forest (tree 20–28 m. high, 43–53 cm. diam.; bark brown, scaly in one, in the other gray, rough; flowers white); 4 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh* 13117, *Brass* 13309, 13630, March 1939, alt. 850 and 900 m., plentiful in rain forest canopy and common subsidiary tree in *Agathis* forest (tree 35 or 25 m. high; flowers white).

NORTHEAST NEW GUINEA: Sambanga, *Clemens* 6957, Sept. 1937, alt. 1500–1800 m. (tall tree 18 in. diam.).

There is some variation in the size of the flowers of the collections cited above. The length of the calyx-lobes varies from 1.4–2 mm. long, and the pedicels from 1–2 mm. long. The leaves also vary considerably in size, but all seem to be of similar texture and venation; in some specimens the lower surface of the leaf is sparsely and minutely pubescent and small domatia occur in the axils between the primary veins and the midrib. The capsule of this species is 4–5 mm. long (not including the style), with scattered minute hairs on the outside. The seeds are \pm 3 mm. long.

Possibly the following collection belongs here: 2 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 13505*, Apr. 1939, alt. 750 m. The leaves of this specimen are a little coarser than in most of the collections cited above, and the inflorescence (flower buds very young) in one specimen measures 20 \times 25 cm.

Opocunonia trifoliolata Schlechter in Bot. Jahrb. 52: 161. 1914.

BRITISH NEW GUINEA: Central Division, Mafulu, *Brass 5247*, Sept.-Nov. 1933, alt. 1250 m., old secondary forest (tree 8 m. high, with shining smooth leaves and white flowers).

The above cited specimen is probably only a pubescent form of this species. On the lower surface of the leaves there are minute scattered hairs, the base of the lateral leaflets is rounded, while that of the terminal ones is usually cuneate. The leaves are both 3- and 5-foliolate. The axis of the inflorescence is densely pubescent, as are the pedicels, the lower part of the calyx, and the ovary. The filaments are 6 and 8 mm. long.

SPIRAEOPSIS Miquel

In our herbarium the genus *Spiraeopsis* Miq. is represented by thirteen specimens, one from the Celebes, two from Manado, and ten from the Philippines. The genus was originally described as dioecious by Miquel, later emended to monoecious by Koorders in his *Suppl. Fl. Celebes* 1: 22. 1918. Since then B. L. Burtt, in *Kew Bull.* 1936: 462. 1936, in a discussion of *S. celebica* Miq., has indicated that all herbarium specimens seen have been entirely male or entirely female. I have dissected several flowers, all perfect, i.e., possessing both pollen and ovules, and in appearance they are like *figs. 11, 12, 13*, of Koorders' plates *7a, 7b*, which in the legend are designated as "masc." Could it be that the fugacious character of the petals and stamens gives rise to the impression of a pistillate inflorescence?

The genus *Betchea* Schlechter, hitherto regarded as endemic in New Guinea, seems to differ only in having two to five carpels instead of two, rarely three. In this study it is treated as a synonym of *Spiraeopsis*.

KEY TO THE SPECIES

Flowers with mostly 2 (occasionally 3)-loculed ovary.

Lower surface of the leaves glabrous (but conspersely glandular) except midrib and veins.....*S. glabrescens*.

Lower surface of the leaves not glabrous, or if so, leaves 5–9-foliolate.

- Lower surface of the leaves tomentulose, or if glabrous, leaves 5-9-foliolate.....*S. celebica* sensu lato.
- Lower surface of the leaves densely tomentose or pilose-tomentose.
Leaves 3-foliolate; capsule 5-6 mm. long, tomentose; seeds papillose.....*S. Brassii*.
- Leaves 5-foliolate; capsule 3-4 mm. long, shortly villous-tomentose.....*S. pubescens*.
- Flowers with 3-5-loculed ovary.
- Flowers with mostly 3 (occasionally 4)-loculed ovary.
- Leaves 3-foliolate.....*S. fulva*.
- Leaves 5-11-foliolate.
- Leaflets sessile.....*S. canariifolia*.
- Leaflets petiolulate.
- Lower surface of leaflets rufous-tomentose.....*S. rufa*.
- Lower surface of leaflets stellate-puberulous to almost glabrous and glandular.
- Leaflets small, 2.5-7 × 1.3-3 cm.....*S. Clemensiae*.
- Leaflets larger, 8-12 × 3.5-5 cm.
- Leaflets 7-11, gradually acuminate...*S. papuana*.
- Leaflets 5, acutish.....*S. myriantha*.
- Flowers with 4- or 5-loculed ovary.
- Flowers with 4-loculed ovary; under surface of leaves glabrous and glandulose.....*S. pometiiformis*.
- Flowers with 5 (occasionally 4)-loculed ovary; under surface of leaves densely tomentulose.....*S. aglaiaeformis*.

Spiraeopsis celebica (Bl.) Miq. Fl. Ind. Bot. 1(1): 719. 1856; B. L. Burt in Kew Bull. 1936: 462. 1936; sensu lat.

Cunonia celebica Bl. Bijdr. 868. 1826.

SOLOMON ISLANDS: Bougainville: Kupei Gold Field, *Kajewski* 1715, Apr. 1930, alt. 1200 m., rain forest (tree up to 30 m. high; fruit brown when ripe splitting into two parts, length without style 5 mm., diam. 2.5 mm.); Buin, Koniguru, *Kajewski* 2113, Aug. 1930, alt. 900 m., rain forest (tree up to 25 m. high; flowers with green sepals, very long stamens, and a faint sweet odor). Ysabel: Tiratona, *Brass* 3214, Nov. 1932, alt. 600 m., common in mountain rain forests (tall tree with thin gray bark; fruit brown).

There is considerable variation in the pubescence of these three collections as is also true of the other material of this species at hand. But until such time as a critical examination of the species can be made, it seems preferable to place the material here.

Spiraeopsis aglaiaeformis (Kaneh. & Hatus.) Perry, comb. nov.

Betcha aglaiaeformis Kanehira & Hatusima in Bot. Mag. (Tokyo) 56: 106, fig. 2. 1942.

NETHERLANDS NEW GUINEA: Angi, Arfak Mts., *Kanehira & Hatusima* 13907 (ISOTYPE), Apr. 1940, alt. 1900 m., in forest along Iray River to Lake Gita (tree 15 m. high, 20 cm. diam.); 9 km. northeast of Lake Habbema, *Brass & Versteegh* 10476, Oct. 1938, alt. ± 2700 m., rare in primary forest (tree 34 m. high, 30 cm. diam.; wood rose; bark gray, fairly smooth; flowers and fruits yellow); Bele River, 18 km. northeast of Lake Habbema,

Brass & Versteegh 11138, Nov. 1938, alt. 2350 m., frequent in primary forest (tree 31 m. high, 42 cm. diam.; bark gray, rough; wood rose; flowers brown); 15 km. southwest of Bernhard Camp, Idenburg River, *Brass 12231*, Jan. 1939, alt. 1700 m., in rain forest ravine (tree 5 m. high, 10 cm. diam.; flowers white).

NORTHEAST NEW GUINEA: Sambanga, *Clemens 6835*, Aug. 1937, alt. 1500–1800 m., margin of mountain forest (frequent big tree).

Among the fruits I have found three, four and five locules but mostly the last mentioned. The leaves are 3-, 5- or 7-foliolate, with the 3-foliolate opposite the 5-foliolate ones.

***Spiraeopsis rufa* (Schlechter) Perry, comb. nov.**

Betchea rufa Schlechter in Bot. Jahrb. 52: 148, f. 4, A-G. 1914.

NORTHEAST NEW GUINEA: Yunzaing, *Clemens 3872*, Aug. 1936, alt. 1350 m.; Quembung, *Clemens 3195*, June 1936, alt. 750 m., forest hills (tall tree 10–12 in. diam.; flower purplish, stamens purple-red, anthers pale yellow; fruits brown, 3-fid, purple inside); Sattelberg, *Clemens 2216*, Apr. 1936, alt. \pm 1000 m., in forest.

In flowers and pubescence these three specimens match *Schlechter 17086*, one of the numbers cited in the original description. The capsules are 3 mm. long, valves \pm 1 mm. broad; seeds including the wings 1 mm. long.

***Spiraeopsis fulva* (Schlechter) Perry, comb. nov.**

Betchea fulva Schlechter in Bot. Jahrb. 52: 148. 1914.

We have no specimen which matches this species, but it should be compared with *S. glabrescens* Perry.

***Spiraeopsis Brassii* Perry, spec. nov.**

Arbor; ramulis dense subferrugineo-tomentosis deinde glabratibus, crassiusculis, 5 mm. diam.; stipulis parvis, 5–7 mm. longis, 7–8 mm. latis, subreniformibus vel subrotundis, utrinque tomentosis; foliis trifoliolatis, margine plerumque crenato-dentato interdum fere subintegris, supra rugosis, novellis tomentosis cito glabratibus, subtus dense tomentosis vel breviter sublanatis, foliolis ellipticis terminali interdum obovato-elliptico, 7–11 cm. longo, 4–8.5 cm. lato, apice subacuto vel obtuso vel interdum breviter et obtuse acuminato, basi cuneato vel rotundato, petiolulo 0.5–1.8 cm. longo, lateralibus ellipticis, saepe minoribus, 3–7 cm. longis, 2.3–5.4 cm. latis, apice obtusiusculis, basi plerumque inaequaliter rotundatis interdum cuneatis, subsessilibus vel sessilibus, venis primariis utrinsecus 8–12 patentibus ascendentibus prope marginem furcatis \pm anastomosantibus, supra impressis subtus prominulis, venulis supra perspicuis; petiolo 1.5–3 cm. longo, dense tomentoso; inflorescentiis tomentosis, 15 cm. vel. ultra, multifloris; pedicello 1–1.5 mm. longo; floribus 4–5-meris; calycis tubo 1 mm. longo, lobis 1–1.5 mm. longis; petalis circiter 1.5 mm. longis, obovato-oblongis; filamentis petalis aequalibus, antheris 0.5 mm. longis latisque apiculatis; disco 10-lobulato; stylis 2, circiter 1 mm. longis; ovario dense

tomentoso 2-loculari, pluri-ovulatis; capsula 5–6 mm. longa, seminibus 2–2.5 mm. longis (alis inclusis) minute papillois.

NORTHEAST NEW GUINEA: Sarawaket, *Clemens* 6050 (in fruit), 7535a (leaves and very young flower buds), Apr., Nov. 1937, alt. 2400–2700 and 2100 m.; vicinity of Samanzing, *Clemens* 9511, Jan. 1939, alt. 2100–2400 m. (tree with brown fruit).

BRITISH NEW GUINEA: Central Division, Mt. Tafa, *Brass* 4852 (TYPE), May–Sept. 1933, alt. 2700 m., on cleared summit (bushy small tree 4 m.; underside of leaves densely brown pubescent); same locality, *Brass* 5024, alt. 2400 m., very common in valley forests (tree up to about 30 m. high; irregular scant-foliaged crown; branchlets stiff; profusion of small green flowers; fruit not seen).

In the last specimen cited there is only one old leaf (not as rugose on the upper surface as those of the other specimens), the rest are immature, but the lateral leaflets are sessile and the margin is inconspicuously serrate-dentate; the inflorescence is broken, but the main axis is 26.5 cm. long, the branches on one side (the others are broken off) are 10–12 cm. long, the pubescence of the whole plant is definitely tomentose. In the other specimens the lower surface of the leaves is almost lanate or villous-tomentose, the upper noticeably rugose. Until more material is at hand it seems best to accept all as one species. No other species of the genus which I have seen has papillose seeds or as thick pubescence.

Spiraeopsis pubescens Perry, spec. nov.

Probabiliter arbor; ramulis tomentosis crassiusculis, \pm 5 mm. diam.; stipulis non visis; foliis 5-foliolatis, coriaceis, inconspicue serratis, supra rugulosis stellato-pilosulis, subtus brunnescentibus dense stellato-pilosis vel piloso-tomentosis, foliolis 7–17 cm. longis, 4–9 cm. latis, ellipticis vel ovato-ellipticis, terminali basi cuneato, petiolulo 0.7–2.5 cm. longo, lateralibus basi rotundatis vel rotundato-cuneatis, apice brevissime et obtuse acuminatis vel acutiusculis, venis primariis utrinsecus 12–16 oblique patentibus prope marginem \pm anastomosantibus, supra impressis subtus prominulis, venulis supra distincte manifestis, petiolulis 3–6 mm. longis; petiolo 3–4 cm. longo et rhachide tomentosis; inflorescentiis multifloris, juvenilibus \pm 20 cm. longis, dense tomentosis, in fructu 28 cm. longis, ramis inferioribus 15 cm. longis; pedicellis 1 mm. longis; floribus 5-meris; calyce 1.5 mm. longo (incl. lobis vix 1 mm.); petalis (siccis) 1 mm. longis, spathulatis; filamentis 2 mm. longis, antheris ovatis apiculatis; disco 5-lobato; ovario dense subvillosa-tomentoso, stylis 2 vix 1.5 mm. longis; capsula 3–4 mm. longa, \pm 2 mm. lata, seminibus vix 1.5 mm. longis, minute rugulosis vel \pm reticulatis.

NORTHEAST NEW GUINEA: Yoangen, *Clemens* 3429 (TYPE), June 1936, alt. 1500–1800 m. (specimen with infructescence and one separate leaf); Ogeranang, *Clemens* 4802, Dec. 1936, alt. about 1800 m. (specimen with very young inflorescence, branches not yet elongated).

The pubescence of this species is of longer hairs and more dense than that of *S. rufa* (Schltr.) Perry, and practically as long as that of *S. Brassii*

described above. In fact, the latter differs only in the trifoliolate leaves (but some species have 3-7-foliolate leaves), the slightly larger capsules usually with shorter stellate tomentum, and minutely papillose seeds.

***Spiraeopsis glabrescens* Perry, spec. nov.**

Arbor; ramulis minute stellato-puberulis fuscis; stipulis circiter 1 cm. longis, 1.5 cm. latis, late rotundatis, basi subtruncatis deinde 3-5 mm. stipitatis, margine \pm dentatis utrinque stellato-puberulis; foliis 3-5-foliolatis, novellis supra consperse stellatis subtus dense glandulosis, maturis subcoriaceis margine serrulatis, supra fere glabris, costa nervisque \pm puberulis, subtus consperse glandulosis, costa nervisque \pm dense stellato-puberulis, foliolis ellipticis vel obovato-ellipticis, 8-16 cm. longis, 4.5-8 cm. latis, terminali basi cuneato, petiolulo 0.5-1.5 cm. longo, lateralibus basi inaequaliter rotundato-cuneatis, apice subabrupte et breviter acuminiatis, venis primariis utrinsecus 11-15 oblique ascendentibus prope marginem \pm furcatis arcuatim anastomosantibus, supra impressis subtus prominulis, venulis subtus manifestis, petiolulis \pm 4 mm. longis; petiolo 2-5 cm. longo et rhachide consperse glandulosis et minute stellato-puberulis, infructescentiis 17 cm. vel ultra, axi et ramulis dense tomentellis; pedicellis vix 1 mm. longis; floribus 5-meris; calycis lobis vix 1 mm. longis, acutis; petalis et staminibus non visis; disco 5-lobato, lobis bilobulatis; capsula dense glandulosa et tomentella, 4 mm. longa (incl. stylis 1 mm.), 2(-3)-valvata; seminibus (incl. alis) 1 mm. longis.

NORTHEAST NEW GUINEA: Sambanga, *Clemens* 7052A (TYPE), Sept. 1937, alt. 1500-1800 m. (an infructescence, a new shoot and a separate 5-foliolate leaf); Sarawaket trail above Kaile forest, *Clemens* 4966, Jan. 1937, alt. 1650-1800 m. (a medium-sized felled tree in a heap of debris).

The nearest approach to this species seems to be *S. fulva* (Schltr.) Perry according to the description of the latter. Both have 3-foliolate leaves, very short pubescence, and very small flowers on very short pedicels. However, in *S. fulva* (Schltr.) Perry the lower surface of the leaves is densely pubescent, the ovary stellate-villous and 3-loculed.

***Spiraeopsis Clemensiae* Perry, spec. nov.**

Arbuscula \pm 12 cm. diam.; ramulis gracilibus, 3-4 mm. diam., brunnescentibus, glandulosis et minute stellato-puberulis; stipulis rotundatis, 5 mm. longis latisque tomentellis; foliis 5-7-foliolatis, 10-14 cm. longis, novellis dense glandulosis et stellato-tomentosis cito glabratibus, maturis coriaceis serratis, supra pallide olivaceis fere glabris, costa \pm puberula, subtus brunnescentibus, costa et venis minute stellato-puberulis ceterum glabris et consperse glandulosis, foliolis oblongis, 2.5-7 cm. longis, 1.3-3 cm. latis, apice breviter acuminiatis vel acutiusculis vel obtusis, basi obtusis vel cuneatis, venis primariis utrinsecus \pm 11 patenti-ascendentibus, arcuatis, supra impressis subtus conspicuis, terminalis petiolulo \pm 1.5 cm. longo, lateralibus basi leviter inaequalibus, petiolulis 3-7 mm. longis; petiolo vix 1.5-2.5 cm. longo et rhachide stellato-puberulis; inflorescentiis multifloris, 14 (in fructu 24) cm. longis, axi et ramulis dense stellato-tomentellis; pedicellis 1 mm. longis; calyce minute stellato-puberulo, tubo

0.5 mm. et lobis 1 mm. longis, 0.8 mm. latis, acutis; petalis et staminibus non visis; disco 10-lobato; ovario circiter 1 mm. longo tomentello, stylis 3, vix 1 mm. longis; capsula circiter 4 mm. longa (stylis inclusis), 3-valvata, seminibus \pm 1.5 mm. longis (alis inclusis).

NORTHEAST NEW GUINEA: Morobe District, *Clemens* 6049, Mar. 1937, alt. 2400–2700 m. (a fruiting specimen without further data); Sattelberg, Masak R.R., *Clemens* 7568 (TYPE), Nov. 1937, alt. 1800–2400 m., in mountain forest (treelet 5 in. diam.).

Spiraeopsis myriantha (Schltr.) Perry, comb. nov.

Betchea myriantha Schlechter in Bot. Jahrb. 52: 150. 1914.

NETHERLANDS NEW GUINEA: Bele River, 18 km. northeast of Lake Habema, *Brass & Versteegh* 11137, Nov. 1938, alt. \pm 2350 m., common in old secondary forest (tree 22 m. high, 33 cm. diam.; bark brown-green, smooth; wood white; flower-buds red).

This specimen for the most part has very immature flower buds. The leaves fall within the measure of those given for this species and are 5-foliate, but they are almost glabrous on the lower surface. The inflorescence is about 20 cm. long. The three flowers dissected had 4-loculed ovaries, whereas the original description points to 3-loculed ones. When there is opportunity to examine the isotype, this collection may be found to belong elsewhere.

Spiraeopsis papuana (Pulle) Perry, comb. nov.; vel aff.

Ackama papuana Pulle in Nova Guin. 8: 645. 1912.

Betchea papuana (Pulle) Schlechter in Bot. Jahrb. 52: 150. 1914, in Nova Guin. 12: 491. 1917.

BRITISH NEW GUINEA: Central Division, Ononge Road, Dieni, *Brass* 3957, May 1933, alt. 500 m., rain forest (slender sparsely foliated tree 10 m. high; indumentum brown; upper surface of leaves shiny; inflorescence reddish brown).

This collection differs in several respects from the original description, but the description of the leaflets is within the limits of the specimen at hand; however, this leaf is 5-(rather than 3-) jugate. The leaflets vary in size, one measures 16×5 cm., and the apex is long-acuminate (2 cm.). The inflorescence is 50 cm. long (including a peduncle of 14 cm. below the lowest branches), but in other collections the size of the inflorescence varies considerably; the number of styles is usually 3, although sometimes only 2. Another difference which should be pointed out is that Professor Pulle does not mention the stellate pubescence of the inflorescence, which is a key character of the genus. In conjunction with this species *S. pometiiformis* Ridl. ought to be examined.

CERATOPETALUM Smith

Ceratopetalum tetrapterum Mattfeld in Jour. Arnold Arb. 20: 432. 1939; Kanehira & Hatusima in Bot. Mag. (Tokyo) 56: 108. 1942.

NETHERLANDS NEW GUINEA: 6 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh* 12516, Feb. 1939, alt. 1200 m. (occasional

tree 30 m. high, 58 cm. diam.; flowers white; fruits dark red); 4 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 13162*, Mar. 1939, alt. 800 m., occasional, slopes of primary rain forest (tree 32 m. high, 43 cm. diam.; sap red; flowers white); 2 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 13183*, alt. 750 m., frequent on slopes in primary rain forest (tree 20 m.; fruits dark red); Boemi, Nabire, *Kanehira & Hatusima 12801*, Mar. 1940, alt. 300 m., in *Agathis* forest.

NORTHEAST NEW GUINEA: Wareo, *Clemens 1618*, Jan. 1936, alt. \pm 600 m.

BRITISH NEW GUINEA: Oroville Camp, Fly River (30 miles above D'Albertis Junction), *Brass 7405* (ISOTYPE).

Although the leaves show considerable variation in size and may be oblong or obovate-oblong, acute, obtuse, or obtusely acuminate, all appear to belong to one species. The flowers are rather small and the calyx-tube densely hirtellous; calyx-lobes four, outside sparsely hirtellous, within densely pubescent except at the very base, ovate, 2.3 mm. long, 1.5 mm. broad, acutish; petals lacking; filaments 1.3 mm. long, the anthers broadly ovate-elliptic, 0.5 mm. long and broad, the apicula short, not recurved; disk slightly lobed, glabrous; ovary densely pubescent; styles glabrous.

Ceratopetalum succirubrum C. T. White of North Queensland is probably the nearest related species, but the leaves are smaller and lanceolate, and the anthers have a fairly prominent apiculus.

SCHIZOMERIA D. Don

The specific characters of this genus appear to be highly variable and difficult to define. Some fruits may be ellipsoid or broadly so in the younger forms and apparently become practically globose at maturity. The pubescence of the inflorescence is variable. The petals are fugacious and often irregular. With only the descriptions of *S. floribunda* Schltr. and *S. Pulleana* O. C. Schm., and very poor material of *S. serrata* Hochr., I have been unable to separate some of the named species at hand satisfactorily from them. For this reason, although these three species have priority, they are not included in the key.

KEY TO THE SPECIES

Leaves ovate, subtruncate at base, small (less than 5 cm. long), on very short petioles.....*S. parvifolia*.

Leaves, if ovate, not subtruncate at base, mostly larger, with longer petioles.

Ovary densely tomentulose or tomentose.

Inflorescences not quickly becoming glabrate; outside of flower tomentulose.

Petioles 2-3.5 cm. long; leaves crenulate-serrulate; flowers short-pedicellate.....*S. Clemensiae*.

Petioles 0.5-1.5 cm. long; leaves crenate-serrate; flowers sessile.....*S. Versteeghii*.

Inflorescences quickly becoming glabrate; outside of flowers usually pubescent on the pedicel and the calyx-tube, the calyx-lobes glabrous or with scattered hairs.

- Leaves oblong-elliptic or ovate-elliptic to lance-elliptic, the primary veins close (5-9 mm. apart) but widely spreading, the lower ones subhorizontal.
- Fruit oblong-ovoid; leaves not glandular on the lower surface.....*S. orthophlebia*.
- Fruit globose; leaves minutely glandular on the lower surface.....*S. novoguineensis*.
- Leaves elliptic; the primary veins rather remote (1-2 cm. apart), spreading-ascending.....*S. Whitei*.
- Ovary pilose to glabrous (if somewhat tomentulose, flowers very small, not more than 4 mm. across).
- Leaves glandular on the lower surface, glands visible without a lens; flowers 4-merous.....*S. adenophylla*.
- Leaves not glandular on the lower surface, or if glandular, glands very minute and not visible without a lens; flowers mostly 5-6-merous.
- Leaves lanceolate or oblong-lanceolate, gradually acuminate..
.....*S. gorumensis*.
- Leaves elliptic, or if lanceolate only acute or abruptly acuminate.
- Fruit ellipsoid; flowers practically glabrous (ovary with few scattered hairs).....*S. katastega*.
- Fruit globose or subglobose.
- Leaves coriaceous or thinly coriaceous; ovary \pm densely pilose; flowers small (calyx lobes 1.5-2 mm. long).....*S. Brassii*.
- Leaves firmly coriaceous; ovary entirely glabrous; flowers larger (calyx lobes 2.5-3 mm. long)..
.....*S. ilicina*.

Schizomeria parvifolia Perry, spec. nov.

Arbor 13-14 m. alta; ramulis brunneo-ferrugineis, glabris; stipulis oblongis, subtruncatis, 7 mm. longis, 2 mm. latis; foliis valde coriaceis 3-4.5 cm. longis, 1.8-3 cm. latis, ovatis, obtusis, basi subtruncatis, margine crenulato-serrulatis, supra nitidis, pallide olivaceis, subtus olivaceis, dense reticulatis, venis primariis utrinsecus 10-12 supra interdum paululo impressis, subtus non elevatis, oblique patentibus prope marginem arcuatis et \pm furcatis; petiolo 2-5 mm. longo, 2 mm. lato, brunnescente; infructescentiae axi 2.5 cm. longo, glabro; fructibus ovoideis, 2.4 cm. longis, 1.8 cm. crassis.

BRITISH NEW GUINEA: Central Division, Wharton Range, Murray Pass, Brass 4576 (TYPE), June-Sept. 1933, alt. 2840 m., common through forests (straight boled tree up to 13-14 m. with compact, densely foliated crown of stiff erect branches; reddish brown fruit).

In foliar characters this species is very distinct from the rest at hand. The small ovate leaves on very short petioles are pale greenish yellow with shining upper surface, under a lens very smooth except for a few slightly impressed lines marking some of the primary veins, yet if examined without a lens the primary veins may be easily counted. On the lower

surface the venation is the same color, but the small and shallow depressions between the veinlets (fairly coarse in this species) are slightly darker.

Schizomeria adenophylla Perry, spec. nov.

Arbor parva, 2–3 m. alta; ramulis cinereis, glabris; alabastris terminalibus vernicosis; stipulis oblongis, \pm 4 mm. longis 1.5–2 mm. latis, obtusis, glabris; foliis tenuiter coriaceis, lanceolate-ellipticis vel ellipticis, 3.5–6 cm. longis, 2–3 cm. latis, apice acutiusculis vel obtusis, basi cuneatis deinde decurrentibus, margine crenulato-serrulatis, glabris, supra olivaceis, inter venas dense reticulatis, subtus brunneo-olivaceis, reticulatis, glandulosis, glandulis minutis sine lente manifestis, costa utrinque prominula, venis utrinsecus 6–8, oblique ascendentibus prope marginem furcatis et arcuatim conjunctis utrinque paululo elevatis; petiolo 2–5 mm. longo; inflorescentiis 1.5 cm. longis, glabris; floribus 4-meris; pedicello 1 mm. longo; calycis lobis vix 2 mm. longis latisque, acutiusculis; petalis \pm 1 mm. longis, trifidis; filamentis 1.5 mm. longis, antheris apiculatis, 0.7×0.5 mm.; disco 4-partito, gibberibus bilobis; stylis 1 mm. longis; ovario glabro, 2-loculare; loculis 2-ovulatis.

BRITISH NEW GUINEA: Central Division, Wharton Range, Murray Pass, *Brass 4661* (TYPE), June–Sept. 1933, alt. 2840 m.; common in forest borders (small tree or large bush 2–3 m. tall; leaves pale, stiff; flowers greenish, ovary brown).

In the size of the leaves this species approaches *S. ilicina* (Ridl.) Schltr.; but in the description of the latter there is no indication of glands on the leaves, whereas in this species they can be seen without a hand lens. Then too, the nerves are obvious and the stipules oblong.

Schizomeria gorumensis Schlechter in Bot. Jahrb. 52: 157, f. 7, *H-O*. 1914.

NETHERLANDS NEW GUINEA: 6 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 12566, 12599*, Feb., Mar. 1939, alt. 1300 and 1250 m., frequent on slopes in primary rain forest (tree \pm 25 m. high, bark brown or black, with some colorless resin; sapwood rose, heartwood dark brown, flowers white; fruits brown); 2 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 13192*, Apr. 1939, alt. 800 m., frequent in primary rain forest; Bernhard Camp, Idenburg River, *Brass & Versteegh 13566*, Apr. 1939, alt. 570 m., occasional in primary rain forest (tree 21 m. high, 53 cm. diam.; bark brown, with a little light red resin; sapwood rose, heartwood dark brown; flowers light yellow).

The leaves are acuminate but mostly not obtusely so, and there is a slight variation in both the size (4.5–7.5 cm. long, 1.2–2.5 cm. broad) of those of the first two collections cited above, and also in the length of the petiole (5–7 mm. long); nevertheless, the lack of apparent floral differences or those of foliar texture suggests that these collections belong to *S. gorumensis* Schltr. The last two collections cited are almost a perfect match for the figure of *S. Ledermannii* Schlechter. However, the ovary is pilose with fairly short hairs rather than densely villous as given in the

original description, the flowers are hardly more than 1 mm. pedicellate, although the fruits (ovoid to subglobose \pm 1 cm. in diameter) are on pedicels 3–5 mm. long. If *S. Ledermannii* Schltr. is separable from *S. gorumensis* Schltr., these collections are more like *S. gorumensis* Schltr. in floral characters. On the under surface of the leaves, with the aid of a lens, one may find very minute and scattered glands.

Schizomeria novoguineensis Perry, spec. nov.

? Arbor \pm 6 cm. diam.; ramulis \pm atro-cinereis, glabris; stipulis oblongis acutiusculis, resinosis, 4 mm. longis, vix 2 mm. latis; foliis coriaceis, ovato-ellipticis vel lanceolato-ellipticis vel ovatis, 5.5–9.5 cm. longis, 2.8–5 cm. latis, apice anguste obtusis vel acutiusculis, basi subrotundatis vel cuneatis, margine crenatis, utrinque glabris, novellis puberulis, subtus consperse et minutissime glandulosis, venis primariis utrinsecus 13–17 supra manifestis, subtus prominulis, late patentibus fere horizontalibus, bifurcatis prope marginem anastomosantibus, venulis utrinque dense reticulatis; petiolo 0.7–1.8 cm. longo; inflorescentiis immaturis 5 cm. longis, ferrugineo-tomentellis; floribus 5–6-meris fere sessilibus, extus puberulis, calycis lobis ovatis, \pm 1.5 mm. longis, acutis; petalis \pm 1 mm. longis, trifidis, staminibus calycem aequantibus, antheris 0.5 mm. longis, ellipsoideis apiculatis; stylis 0.7 mm. longis, ovario dense tomentello, 2(or 3)-loculare; loculis 4-ovulatis; infructescentiis 9 cm. longis; fructibus globosis 1.5 mm. diametro.

NORTHEAST NEW GUINEA: Ogeramngang, *Clemens* 4763 (TYPE), Dec. 1936, alt. \pm 1170 m.; Matap, *Clemens* 41075, Feb.-Apr. 1940, alt. 1500–1800 m. (2.5 inches diameter; flowers dull cream color).

In the rather close and widely spreading primary veins this species approaches *S. orthophlebia*, but the leaves of the latter are oblong-elliptic and the fruit elongate-ovoid as well as much larger than that of *S. novoguineensis*.

Schizomeria orthophlebia Perry, spec. nov.

Arbor usque 32 m. alta, 55 cm. diam.; ramulis glabris \pm compressis, nodis incrassatis; stipulis triangularibus 5–7 mm. longis, 5 mm. latis, obtusis, caducis; foliis \pm valde coriaceis, oblongo-ellipticis, 6–14 cm. longis, 2.5–6.3 cm. latis utrinque angustatis, basi rotundatis, apice obtusis vel acutiusculis (vel breviter et obtuse acuminatis), margine crenulato-serratis, utrinque glabris, novellis crispe pilosulis, cito glabris, venis primariis utrinque distinctis utrinsecus costam 17–22 inferioribus subhorizontalibus superioribus oblique patentibus prope marginem arcuatim conjunctis utrinque dense reticulatis vel in vetustioribus supra obscure reticulatis; petiolo 0.8–1.7 cm. longo; (inflorescentiis immaturis, 3–10 cm. longis, tomentulosis, bracteis oblongis obtusis; alabastris non expansis, extus tomentulosis, calycis lobis intus versus apicem puberulis; antheris ellipsoideis apiculatis; ovario tomentello 2-loculari, loculis 4-ovulatis) infructescentiae axi 7–14 cm. longo, tomentello; fructibus 2–4 cm. longis, 1.2–2 cm. latis, oblongo-ovoideis, basi 2 mm. pedicellatis.

NETHERLANDS NEW GUINEA: 9 km. northeast of Lake Habbema, *Brass & Versteegh 10463* (TYPE), Oct. 1938, alt. \pm 2750 m., along a stream in forest, common (tree 32 m. high, 55 cm. diam.; bark brown, fairly smooth; fruit green); Bele River, 18 km. northeast of Lake Habbema, *Brass & Versteegh 11161*, Nov. 1938, alt. 2230 m., on slope of a ridge in secondary forest, common (tree 16 m. high, 34 cm. diam.; bark black, rough, flower-buds soft green).

In the material at hand this species is easily recognized by the crenulate-serrulate oblong-elliptic leaves with fairly numerous (straight for $\frac{3}{4}$ of the distance to the margin) and almost horizontal primary veins. No other species seen has elongate-ovoid obtusely pointed fruit. Apparently it develops only one seed. Even though the inflorescences are given as 3–10 cm. long, all are very immature, and it is quite possible that in those measuring 5–10 cm. long the subtending new leaves have dropped off in process of drying.

Schizomeria ilicina (Ridl.) Schlechter in Bot. Jahrb. 55: 194. 1918.

Cremnobates ilicina Ridley in Trans. Linn. Soc. II. Bot. 9: 41, pl. 3, figs. 56–63, pl. 4, fig. 55. 1916.

NETHERLANDS NEW GUINEA: Bele River, 18 km. northeast of Lake Habbema, *Brass & Versteegh 11106*, Nov. 1938, alt. 2200 m., occasional in primary forest (tree 18 m. high, 30 cm. diam.; flower buds red; fruit green-brown); Balim River, *Brass & Versteegh 11188*, Dec. 1938, alt. 2160 m., in forested slopes (tree 15 m. high, 40 cm. diameter; flowers white; fruit green); 15 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 11932*, *Brass 12150*, Jan. 1939, alt. 1780 and 1800 m., one of the larger trees in the mossy forest, not common; 6 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 12571*, *12583*, *12763*; Feb. 1939, alt. 1300 and 1200 m., occasional in primary forest (tree 18–22 m. high, bark black, rough; fruit brown; flowers white); 4 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 13114A*, *13114*, Mar. 1939, alt. 900 and 850 m.; frequent in primary rain forest (tree 25 m. high, 56 cm. diam.; bark gray, fairly smooth; flowers white; fruits brown).

NORTHEAST NEW GUINEA: Ogeramnang, *Clemens 4650*, *4794*, *4997*, *5114a*, *6358*, Dec. 1936, Jan. 1937, and May 1937, alt. 1500, 1800, 1650, 1740, and 1750 m. respectively; in mossy forest (tree 75–85 ft. high); Sambanga, *Clemens 6845*, *7744a*, Nov. 1937, alt. 1500–1800 m., margin of clearing in mountain forest (tree 10–12 inches in diameter; fruit pale khaki color); Matap, *Clemens 41027*, Feb.-Apr. 1940, alt. 1500–1800 m. (tree 2 ft. diam.; flower buds immature, pale).

In designating all these collections as *Schizomeria ilicina* (Ridl.) Schltr. possibly more than one entity is included; certainly great variability is shown. Unfortunately, we have flowers and fruit of only a few numbers; however, the obvious differences between the specimens and Ridley's description and figures will be noted.

In the first place Ridley's description indicates 5-merous flowers and the figure a 4-merous one. Of the several flowers examined in this study, all are either 5- or 6-merous; apart from that, their pistils do not match that in the figure. Ridley's description "ovarium . . . uniloculare, uniovulatum"

does not fit any *Schizomeria* which I have examined. Perhaps, Ridley assumed such a structure from an examination of the fruit; the styles sometimes are very short, but most of them are as long or almost as long as the calyx-lobes. In *Brass & Versteegh 12583* the inflorescence is 1.8 cm. long and glabrous, with flowers slightly smaller than those in the other collections. The leaves are $5-7 \times 2.5-4$ cm., and the reticulations of the leaf are very dense (the shallow hollows between the veinlets are about half as large as those in most of the other specimens). This specimen may represent *S. ilicina* (Ridl.) Schlechter in the strict sense of the specific definition. On the other hand, *Brass & Versteegh 13114A* has inflorescences up to 9 cm. long with slightly larger flowers, the axis and branchlets of the inflorescence \pm densely puberulous, and the leaves with a similarly dense but less easily distinguished reticulation. *Brass & Versteegh 11188, 13114*, and *Brass 12763* have puberulous or tomentulose inflorescences \pm 3 cm. and 7 cm. long respectively, leaves 4.5–14.6 cm. long, 2–6 cm. broad, the apex varying from rounded to subacute, the base mostly cuneate but sometimes rounded-cuneate or rounded, the margin \pm crenulate-serrulate, and both surfaces obviously somewhat more loosely reticulate than in the two specimens discussed above. The calyx-lobes are 2–2.5 mm. long, the petals about as long, the stamens as long or slightly longer, and the ovary 2–3-loculed, each locule 4-ovulate. Sometimes when the ovary is 3-loculed, one locule has only 2 ovules.

Brass & Versteegh 11106, 11188, 11932, and *Brass 12150* are specimens with fruit. The second has very immature fruits, some as small and narrow as in Ridley's description while others are almost as broad as long. In the other collections the fruit is subglobose and up to 2 cm. in diameter. The material from Northeast New Guinea in some specimens has leaves that are more coriaceous and larger ($7.5-17 \times 3.5-10$ cm.), but the flowers and fruit are very like those from Netherlands New Guinea.

Brass & Versteegh 12571 may not belong to this species but is surely very closely allied. The fruits are large, one measuring $4 \times 3.7 \times 3.5$ cm. The leaves are firmly coriaceous and rounded at the base. One very young reddish tomentose inflorescence was collected. The bud-scales are round rather than oblong or lanceolate as in the other specimens of the species.

Schizomeria Whitei Mattfeld in Jour. Arnold Arb. 20: 435. 1939.

NORTHEAST NEW GUINEA: Boana, *Clemens 41770*, May-Nov. 1940, alt. 750–1350 m. (flowers dull flesh-gray).

After setting up this collection as a new species from New Guinea, I found I could not separate it in my key from *S. Whitei* Mattf. collected on the Atherton Tableland, Queensland. The leaves are slightly less brittle, the veins stand out a little more on the lower surface, the leaves are cuneate at base (but this is true in some of those in *Kajewski 1135*), and the inflorescence is slightly more tomentulose. These variations do not appear sufficient to be considered specific.

Schizomeria katastega Mattfeld in Jour. Arnold Arb. 20: 433. 1939.

Schizomeria tegens Mattf. op. cit. 434.

BRITISH NEW GUINEA: Western Division: Oriomo River, Wurui, *Brass* 5804, Jan.-Mar. 1934, alt. 10-30 m., common in small forest clumps on savannah (tree 10-12 m. high; flowers white; pale fleshy fruit); Oroville Camp, Fly River, *Brass* 7429; Lake Daviumbu, Middle Fly River, *Brass* 7497, 7898; Gaima, Lower Fly River (east bank), *Brass* 8294.

Perhaps the field notes of Brass indicating two collections as canopy trees and the other two as substage trees is a little misleading. Without this I am sure it would be difficult to separate them. There is a slight variation in the size of the flowers, but such is true even in a single collection. I am not sure that *S. homaliiformis* Kaneh. & Hatus. is distinct from this species. On the whole the flowers are smaller and more numerous, but the inflorescences are still young.

Schizomeria Brassii Mattfeld in Jour. Arnold Arb. 20: 435. 1939, vel aff.

SOLOMON ISLANDS: Bougainville: Koniguru, Buin, *Kajewski* 2015, Aug. 1930, alt. 800 m., rain forest (tree up to 30 m.); Hogoro, Maisua, *Waterhouse* 81, Sept. 1932, alt. \pm 360 m. (tree 40 ft.). Guadalcanal: Uulolo, Tutuve Mt., *Kajewski* 2580, Apr. 1931, alt. 1200 m., rain forest (tree up to 30 m. high; bark covered with large corky pustules; fruit 1.3 cm. long, 1.5 cm. diam.). Ysabel: Tataba, *Brass* 3428, Jan. 1933, alt. 50 m., rain forest ridges, common (very large flanged tree with deeply channelled rough gray bark and hard brown wood; leaves smooth and shining; flowers white).

The type-specimen of *S. Brassii* Mattf. has only fruits and leaves. These are a fairly good match for *Kajewski* 2580 from Guadalcanal. Until an isotype of *S. floribunda* Schltr. and good material of *S. serrata* Hochr. is available for study with this species, these determinations must be accepted as tentative.

Schizomeria Clemensiae Perry, spec. nov.

Arbor magna; ramulis atro-cinereis vel brunnescentibus 5-8 mm. diametro, novellis tomentellis; stipulis non visis; foliis coriaceis, ovato-ellipticis 8.5-19 cm. longis, 4.5-8.5 cm. latis, apice obtusis vel subrotundatis, basi rotundatis deinde in petiolo breviter decurrentibus, margine crenulatis, in sicco olivaceis, supra inconspicue subtus manifeste reticulatis, venis primariis utrinsecus 12-17 patenti-ascendentibus, prope marginem furcatis \pm anastomosantibus, supra perspicuis, subtus prominulis, petiolo 1.7-3.5 cm. longo, subrotundato; inflorescentiis \pm 12 cm. longo, ferrugineo-tomentellis; bracteis rotundatis; pedicello 1 mm. longo; flore extus ferrugineo-tomentello vel dense puberulo, expanso 7-8 mm. lato; calycis lobis 3-3.5 mm. longis, 1.8-2.5 mm. latis, ovatis, acutis; petalis 2.5 mm. longis longitudine $\frac{1}{3}$ superiore trifidis; filamentis vix calycis lobos aequantibus, antheris 1 mm. longis 0.7 latis, cordatis, apiculatis; disco 10-gibbo, gibberibus subglobosis 0.8 mm. diametro; ovario 2-3-loculari, dense tomentoso, loculis 4(-5)-ovulatis; stylis 2 vel 3, circiter 2.5 mm. longis;

fructibus novellis ellipsoideis (2×1.5 cm.), maturis globosis, 3 cm. diametro.

NORTHEAST NEW GUINEA: Sattelberg, *Clemens* 439 (TYPE), 1248, Oct. 1935, alt. ± 900 m., margin of forest (tree 50 ft.; flower dull yellow, of the same odor as the fruit); Quembung, *Clemens* 2180, March 1936, alt. ± 600 m., margin of forest (tree of giant size; fruit russet).

This species is perhaps most closely related to *S. Versteeghii*, but in the latter the leaves are crenate-serrate rather than crenulate, the petioles are not more than half as long, and the flowers are sessile.

Schizomeria Versteeghii Perry, spec. nov.

Arbor 27 m. alta, 46 cm. diam.; ramulis glabris crassis sub inflorescentia ± 1 cm. diam., cortice cinereo vel brunnescente \pm rimoso; stipulis non visis; alabastris axillaribus parvis vernicosis; foliis valde coriaceis ellipticis, 10.5–22 cm. longis, 5.7–14 cm. latis, apice rotundatis, basi rotundatis, margine crenato-serratis, utrinque glabris, venis primariis utrinsecus 17–19 inferioribus oblique patentibus superioribus patenti-ascendentibus, marginem versus furcatis vel bi- et tri-furcatis \pm anastomosantibus supra distinctis, subtus prominulis, venis secundariis subtus manifestis, venulis utrinque dense reticulatis; petiolo 0.5–1.5 cm. longo, crassiusculo; inflorescentiis 10–16.5 cm. longis, 15–18.5 cm. latis, saepe basin prope ramosis, multifloris, tomentosis; axi et ramulis crassiusculis; bracteis rotundatis, concavis, 5 mm. longis, 5 mm. latis, caducis; alabastris 7 mm. longis, 5.5 mm. latis, sessilibus; floribus expansis (siccis 9 mm.), 1.2 cm. latis, 5–6-meris; calycis lobis ± 4 mm. longis, 2 mm. latis, ovatis vel lanceolatis, acutis, intus margine et apice puberulis, ceterum glabris; petalis 3.5–4 mm. longis, trifidis, laciniis exterioribus saepe longioribus; filamentis 3.5–4 mm. longis, antheris ellipsoideis, 1 mm. longis, 0.7 mm. latis, apiculo paulo recurvato; disco 10–12-gibbo, 1 mm. alto, 0.9 mm. crasso; stylis 2 vel 3, 2–2.5 mm. longis; ovario tomentoso, 2.5 mm. diametro; loculis 2–3, 4–6-ovulatis, ovulis biseriatis; fructibus immaturis, subglobosis vel late ellipsoideis, ± 1.5 cm. diametro.

NETHERLANDS NEW GUINEA: Bele River, 18 km. northeast of Lake Habema, *Brass & Versteegh* 11129 (TYPE), Nov. 1938, alt. 2300 m., occasional in primary forest (tree 27 m. high, 46 cm. diam.; bark 9 mm. thick, gray, rough, fissured, with a little yellow sap; flowers white; fruits brown).

Schizomeria Versteeghii is most like the collections which have been placed in *S. floribunda* Schltr. The former differs in the much shorter petioles, the crenate-serrate rather than crenulate leaves, and the considerably larger sessile flowers.

AISTOPETALUM Schlechter

At hand are four numbers of the Third Archbold Expedition plants which seem to belong to *Aistopetalum* Schltr. Two have fruits, one has both flowers and fruits, and the other only flower-buds. In addition there is an isotype of *A. tetramerum* Kaneh. & Hatus. The flower-buds of the

latter are so young that it is impossible to determine without dissection whether tetramerous or pentamerous flowers predominate. The specimens *Brass & Versteegh 12513* and *Brass 13170* have both 5- and 6-merous flowers. In one instance a pentamerous flower had six carpels, and in another a hexamerous flower had five carpels. One of the characters indicated in the original description is two collateral ovules in each carpel, a character re-affirmed in the description of *A. tetramerum* Kaneh. & Hatus. Although several flowers from the above specimens have been dissected, none of them appear to have more than one pendent ovule in each carpel. The fruits are ovoid or oblong. The exocarp is fleshy and in some of the dried fruits irregularly cracked at the apex, the endocarp or putamen is bony, 5-6-celled, and at the apex 5-6-pointed bony projections cover a soft area through which probably the germinating seed pushes out. The seed is tear-shaped, the embryo is very slightly fleshy and embedded in endosperm with the radicle pointing toward the apex of the fruit.

Aistopetalum viticoides Schltr. in Bot. Jahrb. 52: 144, f. 2, A-F. 1914; vel aff.

NETHERLANDS NEW GUINEA: 6 km. SW. of Bernhard Camp, Idenburg River, *Brass & Versteegh 12513, 12565, Brass 13286*, Feb., Mar. 1939, alt. 1500, 1280, and 1200 m. respectively, primary forest, on slopes of ridge (occasional tree 15-28 m. high, 15-59 cm. diam.: flowers yellow; fruit orange or yellow); 2 km. SW. of Bernhard Camp, Idenburg River, *Brass & Versteegh 13170*, Mar. 1939, alt. 900 m., primary rain forest, on slope of ridge (frequent tree 20 m. high, 45 cm. diam.; flower-buds yellow-green).

Without more material it is difficult to decide whether the fact that *Brass 13286* and *Brass & Versteegh 12565* have ovoid fruits and *Brass 12565* oblong fruits constitutes a specific difference or only a variation within a species. The ovoid fruits are 1.5-2 cm. long and 1.1-1.9 cm. in diameter, the oblong are 2.2-2.5 cm. long and 1.5 cm. in diameter. The foliar differences are intangible; perhaps the venation in *Brass 12565* is a little less open than in the other specimens. There are no flowers for comparison. There are simple, trifoliolate, and 5-foliolate leaves in specimens of the same collection, sometimes on the same specimen. Schlechter mentions only trifoliolate leaves, but in the figure of the species simple leaves are also shown.

The seed in the fruit opened was about 1 cm. long, the embryo nearly as long, with the cotyledons about twice the length of the radicle.

WEINMANNIA L.

Weinmannia purpurea Perry, spec. nov.

Arbor usque 30 m. alta, glabra; ramulis gracilibus 2-3 mm. diametro, atro-brunnescentibus, levibus, laxe foliatis; stipulis connatis, cito caducis; foliis simplicibus, tenuiter coriaceis, lanceolatis, 8-17 cm. longis, 2.5-4.5 cm. latis, apice obtuse acuminatis, basi cuneatis, margine serrato-dentatis, verisimiliter glanduloso-dentatis, utrinque laxe reticulatis, supra \pm nitidis,

venis primariis utrinsecus 13–20 utrinque manifestis, non prominulis; petiolo 0.5–1.5 cm. longo; racemis plerumque ternis in pedunculo communo, usque 16 cm. longis; axi puberulo; pedicellis 2 mm. longis, sparsim puberulis; floribus 4-meris, pallide purpureis; calyce glabro, lobis 1 mm. longis, oblongo-lanceolatis obtusis; petalis ellipticis 1.5 mm. longis, 1 mm. latis; staminibus 2 mm. longis, antheris apiculatis; glandulis cylindricis, vix 1 mm. longis; ovario sparsim puberulo, stylis circiter 1.2 mm. longis; capsulis oblongis, 6 (stylis inclusis) mm. longis, seminibus (siccis) 1 mm. longis, 0.3 mm. latis, utrinque barbato-pilosis, pilis circiter 1 mm. longis.

SOLOMON ISLANDS: Bougainville: Kupei Gold Field, *Kajewski 1738* (TYPE), April 1930, alt. 100 m., rain forest (tree up to 20 m. high, found growing at very high altitudes; flowers very pale purple on purple stalks; fruit purple, length including styles 6 mm., 1.5 mm. diam.).

Most of the racemes are in threes at the apex of a common peduncle 3–6 cm. long, but in one instance there are two nodes; the lower one has two opposite racemes and the upper has three.

From the description of *W. marquesana* F. Brown, it seems as if these might be related species. The latter has broader and shorter leaves with longer petioles; nothing is said of the stipules. In *W. purpurea*, the short connate stipules, although loose, still encircle the base of the inflorescence and the younger branchlets.

Weinmannia Ledermannii Schlechter in Bot. Jahrb. 52: 162. 1914.

NORTHEAST NEW GUINEA: Wareo, *Clemens 1407*, Dec. 1935, alt. \pm 600 m., margin of jungle (tree 100 ft. high; flowers cream-colored; fruits pale tinged with pink).

The leaves of this collection are 2–5-jugate, the petiole and rhachis are shortly and somewhat densely pilose, the midrib on the lower surface of the leaflets is less densely so. The axis of the inflorescence is only puberulous. Apart from these differences in pubescence the specimen agrees with the description reasonably well.

Weinmannia urdanetensis Elmer, Leaf. Philipp. Bot. 7: 2608. 1915.

NETHERLANDS NEW GUINEA: 15 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 11908*, Jan. 1939, alt. 1800 m., frequent in mossy-forest of ridges (tree 26 m. high; flowers white; fruit red); 8 km. southwest of Bernhard Camp, Idenburg River, *Brass 12733*, Feb. 1939, alt. 1600 m., one of the principal trees in the mossy forests at this altitude.

For the time being I have placed these collections in *W. urdanetensis* Elmer, originally described from the Philippines. There is at hand an isotype of this species and another collection in young fruit (seeds immature) from Mt. Palimlim, Luzon. The lower leaves of the latter specimen are a little larger than in the type and about the same size as the smaller ones in the New Guinean collections. The leaves in these are 4–9-jugate, the lateral leaflets are 0.9–1.8 cm. long and the lower surface is more pilose than in the Philippine material, in which the lower surface is often glabrous except for a few hairs along the midrib; here also the veins are a little less easily seen than in the New Guinean collections. In the latter,

the mature capsules are 4–4.5 mm. long (including the 1 mm. style), the seeds 0.8–0.9 mm. long 0.4 mm. wide, not including the tufts of hairs at the ends of the seeds.

Weinmannia novoguineensis Perry, spec. nov.

Arbor parva, 10–13 cm. diam.; ramulis puberulis vel breviter pilosis; stipulis subreniformibus intus glabris, venosis, extus puberulis, 6–8 mm. longis, 1 cm. latis; foliis 4–10 cm. longis, 4–13-jugis, foliolis chartaceis vel tenuiter coriaceis, serratis, supra costa puberula excepta glabris, subtus costa praecipue parte inferiore dense et breviter pilosa excepta plerumque glabris nonnumquam hinc inde pilis conspersis, terminali lanceolato acutiusculo, 2.2–3 cm. longo, 0.7–1 cm. lato, petiolulo circiter 3 mm. longo, lateralibus 1–2.4 cm. longis, 0.5–0.8 cm. latis, oblongis utrinque angustatis, apice acutiusculis vel obtusiusculis, basi inaequaliter obtusis sessilibus; petiolo vix 1 cm. longo et rhachide \pm crispe pilosulis; infructescentiis \pm 8 cm. longis, axi puberulo vel \pm pilosulo; pedicellis 2–3 mm. longis, puberulis; floribus 4-meris; calycis lobis 1 mm. longis, 0.7 mm. latis, glabris; petalis et staminibus non visis; glandulis 0.5 mm. longis; capsula circiter 6 mm. longa (incl. stylis 1.5 mm.), seminibus 1 mm. longis, 0.4 mm. latis, \pm pilosulis.

NORTHEAST NEW GUINEA: Sarawaket, *Clemens* 7517 (TYPE), Nov. 1937, alt. 1800–2400 m., in mountain forest (small tree 4–5 inches diameter; fruit pale green).

This species differs from *W. Pullei* Schltr. in the sessile leaflets with pubescent midrib on the lower surface, the more heavily pubescent leaf rhachis, the longer pedicels, and the glabrous calyx.

Weinmannia trichophora Perry, spec. nov.

Arbor 12–15 cm. diam.; ramulis parvis tomentosis dense foliatis; stipulis subreniformibus, 4 mm. longis, 5 mm. latis, intus basin versus et extus breviter appresse pilosis; foliis 2–5 cm. longis, 2–7-jugis, foliolis subcoriaceis serrulatis, supra consperse puberulis, subtus (costa dense) breviter appresse pilosis, pilis crispulis, terminali 1–1.5 cm. longo, 0.5–0.7 cm. lato, oblongo obtusiusculo vel acutiusculo, petiolulo circiter 2 mm. longo, lateralibus 0.8–1.6 cm. longis, 0.4–0.6 cm. latis, oblongis acutiusculis vel obtusis, basi vix inaequaliter obtusis sessilibus; petiolo 3–6 mm. longo et rhachide tomentosis; inflorescentiis \pm 5 cm. longis, axi breviter piloso; pedicellis 1.5 mm. longis puberulis; floribus 4-meris, ante anthesin; calyce puberulo, lobis ovatis obtusis 1 mm. longis, 0.7 mm. latis; petalis 1.5 mm. longis, 1 mm. latis, ellipticis; antheris minute apiculatis; glandulis fere 0.4 mm. longis; ovario pubescente, stylis glabris.

NORTHEAST NEW GUINEA: vicinity of Samanzing, *Clemens* 9498 (TYPE), Jan. 1939, alt. 2100–2400 m., in mountain bush (tree 5–6 in. diam.; flowers white-cream).

This species may be related to *W. urdanetensis* Elmer, but the leaves are smaller, the leaflets shorter and broader and much more pubescent on the lower surface.

Weinmannia ysabelensis Perry, spec. nov.

Arbor 25 m. alta; ramulis gracilibus, novellis \pm 2 mm. diam., breviter et patenti-pilosulis, internodiis 1–2 cm. longis; stipulis cito caducis, non visis; foliis (petiolo incluso) 3.5–7.5 cm. longis, 1–4-jugis, foliolis tenuiter coriaceis vel chartaceis, crenulato-serratis, supra atro-olivaceis, glabris, subtus pallidioribus, costa \pm pilosulis, supra laxe subtus dense reticulatis, terminali majore, 2.7–4 cm. longo, 0.8–1 cm. lato, lanceolato, acuto, petiolulo 2–3 mm. longo, lateralibus 1–2.3 cm. longis, 0.5–0.9 cm. latis, oblongo-lanceolatis, apice acutiusculis, basi inaequaliter obtusis, sessilibus vel subsessilibus; petiolo 0.5–1 cm. longo et rhachide supra subplanis obscure marginatis margine glabris, ceterum utrinque patenti-pilosulis; inflorescentiis 5–8 cm. longis, singulis vel binis, axi puberulo; pedicellis \pm puberulis, 2 mm. longis; floribus 4-meris; calycis basi hinc inde minute pilis dispositis, lobis vix 1 mm. longis, ovato-oblongis rotundatis; petalis 1.4 mm. longis, obovato-ellipticis; filamentis 1.4 mm. longis, antheris 0.5 mm. longis minute apiculatis; glandulis cylindricis, 0.4 mm. longis, 0.15–0.2 mm. latis; stylis fere 1 mm. longis, ovario pubescente, circiter 1 mm. longo, 0.7 mm. diam.; capsulis (stylis fere 2 mm. inclusis) 5–6 mm. longis, 1.5 mm. diam.; seminibus circiter 1.5 mm. longis, 0.5 mm. latis, \pm pilosulis.

SOLOMON ISLANDS: Ysabel: Tiratona, *Brass* 3215 (TYPE), Nov. 1932, alt. 600 m., mountain forests, common (thick-boled tree 25 m. tall; reddish brown flaky bark and hard red wood; flower white; fruit pink).

We have no specimens at hand which suggest a close relationship with this species. *Weinmannia virgulata* Schltr. has 2–4-jugate leaves, but 3-merous flowers; *W. Macgillivrayi* Seem. has 5–9-jugate leaves with larger leaflets. It should be noted that the seeds have scattered hairs on the surface, not confined to the ends as in *W. Versteeghii*.

Weinmannia Versteeghii Perry, spec. nov.

Arbor 19 m. alta, 25 cm. diam., fere glabra, ramulis cinereo-brunnescentibus, novellis \pm ferrugineis, minute et sparsim puberulis, ultimis gracilibus, \pm 1 mm. diam.; stipulis subrotundatis 4–7 mm. longis latisque, extus sparsim et minute appresse puberulis; foliis 2.5–5 cm. longis, 1–4-jugis, foliolis glabris, terminali obovato basi anguste cuneato, subsessili, lateralibus oblanceolatis, sessilibus, 0.7–1.8 cm. longis 0.4–0.7 cm. latis, apice obtusis basi anguste et inaequaliter obtusis, margine minute crenulato-serratis, supra (in sicco) atro-olivaceis, costa pallidiora, subtus pallidioribus, venis primariis ascendentibus \pm anastomosantibus utrinque manifestis; petiolo 6–10 mm. longo et rhachide anguste marginatis; racemis vulgo singulis 4–8 cm. longis, axi minute puberulo; floribus 4-meris; calycis lobis 1.3 mm. longis, obtusis, petalis obovato-ellipticis, 1.7 mm. longis, 1.4 mm. latis, rotundatis sparsim ciliolatis; filamentis vix 3 mm. longis; glandulis cylindricis vix 1 mm. longis; ovario puberulo, 2 mm. longo, stylis vix 1 mm. longis; capsulis 6 mm. longis, puberulis, seminibus 1.5 mm. longis utrinque barbato-pilosulis.

NETHERLANDS NEW GUINEA: 9 km. northeast of Lake Habbema, *Brass & Versteegh 10469* (TYPE), Oct. 1938, alt. \pm 2700 m., frequent in forest (sub-stage tree 19 m. high, 25 cm. diameter; bark 4 mm. thick, gray-brown, rough; outer wood yellow, inner red).

This is the only species reported from New Guinea with the narrowly margined petiole and rhachis. In habit it suggests *W. tannaensis* Guillaumin, but in the latter the leaflets are narrower at the apex, and the margin of the petiole and rhachis is broader.

PULLEA Schlechter

In the consideration of the genus *Pullea* Schltr. I am indebted to Dr. F. P. Jonker for very generously providing for comparison two leaves and a branch of the inflorescence from the original collections of *P. glabra* Schltr.

KEY TO THE SPECIES

Flowers tapering into a very short (about 1 mm. long) stipe.....*P. glabra*.
Flowers sessile.

Leaves velvety-pubescent beneath.....*P. mollis*.

Leaves glabrous or only sparsely puberulous with minute hairs.

Leaves acute or very obtusely short-acuminate.

Flowers 10-12 on a cluster; leaves very obtusely short-acuminate, lower surface fasciculate-barbate in axils between the primary veins and the midrib.....*P. Versteeghii*.

Flowers 5-7 in a cluster; leaves acute, not fasciculate-barbate.....*P. decipiens*.

Leaves obtuse, rounded, or emarginate.

Stipules subulate; leaves small, \pm 5.4 \times 3 cm., reticulations prominent.....*P. papuana*.

Stipules oblong-lanceolate, obtuse; leaves larger, 4-9 \times 3-6 cm., reticulations not prominent.....*P. Clemensiae*.

Pullea decipiens Perry, spec. nov.

Arbor 29 m. alta, 45 cm. diam.; cortice novello nigrescente, vetustiore brunneo-cinereo, glabro, lenticellato; foliis in sicco brunnescentibus subtus paullo pallidioribus, coriaceis, lanceolatis vel elliptico-lanceolatis, 3-7.5 cm. longis, 1-3 cm. latis (av. 5-6 \times 2.5 cm.), apice acutis, basi cuneatis in petiolum 3-6 mm. longum angustatis, margine crenulatis, utrinque glabris, venis primariis utrinsecus 7-10, supra manifestis subtus prominulis, venulis creberrimis dense reticulatis; inflorescentiis puberulis, paniculatis, lateralibus vel apicalibus, 2.5-6 cm. longis, saepe 7 ex ramulorum apice ortis; axi 1-3 cm. longo, ramulis 2-8-natim verticillatis nonnumquam iterum verticillatis, 3-15 mm. longis; floribus (post anthesin) parvis, sessilibus, in capitulis (\pm 5-floris); calycis lobis 1.5-1.9 mm. longis, 0.7-1.0 mm. latis, oblongis, obtusis, membranaceis; staminibus circiter 3 mm. longis; disci squamis 0.2-0.3 mm. longis latisque, apice incrassatis, emarginatis, bifoveolatis; stylis 2, liberis, circiter 3 mm. longis, basi exceptis glabris; ovario hemi-infero, extus 1 mm. longo.

NETHERLANDS NEW GUINEA: 4 km. SW. of Bernhard Camp, Idenburg River, *Brass & Versteegh 13115* (TYPE), March 1939, alt. 850 m., primary rain forest on plain; common tree 29 m. high, 45 cm. diam.; bark gray, scaly; wood red-brown; flowers light yellow).

This species of *Pullea* seems to be most like the description of *P. papuana* Gibbs. It differs in having acute, distinctly crenulate leaves with lateral veins more raised than the reticulate areas between them, and flowers with obtuse calyx-lobes. Possibly more material would show the two are identical. One needs to examine the type to evaluate the differences. *Pullea papuana* Gibbs is described as having obtuse minutely denticulate leaves, and acute calyx-lobes.

Pullea Versteeghii Perry, spec. nov.

Arbor usque 31 m. alta, 48 cm. diam.; cortice novello brunnescente, vetustiore pallidiore, glabro, lenticellato; foliis ellipticis vel oblongo-ellipticis, 4.5–10 cm. longis, 2.5–5 cm. latis, apice breviter et obtusissime acuminatis, acumine 4–6 mm. longo latoque, basi obtusis deinde breviter cuneatis, margine crenulato-denticulatis, supra olivaceis glabris, subtus brunnescentibus, venis primariis \pm pubescentibus, in axillis inter costam et venas fasciculato-barbatis, utrinsecus 7–9 patenti-adscendentibus marginem versus breviter furcatis supra perspicuis, subtus prominulis, venulis laxe reticulatis utrinque paullo elevatis sine lente manifestis, minoribus copiose reticulatis supra obscuris subtus sub lente manifestis; petiolo 0.5–1 cm. longo; inflorescentiis dense puberulis, paniculatis, axillaribus et apicalibus, usque 8 cm. longis latisque, circiter 7 ex ramulorum apice ortis; axi 1.5–4 cm. longo; ramulis 2–8-natis verticillatis, nonnumquam iterum verticillatis, 6–20 mm. longis, bracteis 1–1.5 mm. longis vix 0.5 mm. latis, oblongo-ovatis; floribus (post anthesin) parvis sessilibus, in capitulis (circiter 9–12-floris); calycis lobis 2 mm. longis, 1.5 mm. latis; staminibus 2.7 mm. longis; disci squamis 0.5 mm. longis, vix 0.4 mm. latis, apice incrassatis et fere planis; ovario extus \pm 1 mm. longo, apice subconico; stylis 2.5–3 mm. longis inferiore $\frac{1}{3}$ pubescentibus.

NETHERLANDS NEW GUINEA: Bele River, 18 km. NE. of Lake Habbema, *Brass & Versteegh 11123, 11146* (TYPE), *11147*, Nov. 1938, alt. \pm 2300 m., primary and secondary forest (rare tree 13–31 m. high, 35–48 cm. diameter; bark 4–9 mm. thick, rough, white (brown in *11147*); flowers white); Balim River, *Brass & Versteegh 11185*, Dec. 1938, alt. 2160 m., forest of the slopes.

The immediately distinctive character of this species is found on the lower surface of the leaves, the tufts of hair in the axils between the midrib and the primary veins. Also there is a coarse reticulation which can be seen with the naked eye as well as a finer one visible on the under surface only with the aid of a lens. The contrast in the reticulation is much more marked than in *P. decipiens*. The flowers are in clusters of 9–12. The style is more or less pubescent the lower third of its length. *Brass & Versteegh 11147* has lanceolate rather than elliptic leaves, 3–10 cm. long, 1.5–4 cm. wide, and flowers slightly smaller than in the specimen designated as the type.

Pullea Clemensiae Perry, spec. nov.

Arbor 45–90 cm. diam.; cortice brunnescente vel cinereo-brunnescente, lenticellato, glabro, novello minute appresse pubescente; alabastris, stipulis (obtusae oblongo-lanceolatis cito caducis) et foliis novellis dense cinereo-pubescentibus; foliis coriaceis, ellipticis 4–9 cm. longis, 2.3–6 cm. latis, in sicco brunnescentibus apice rotundatis vel obtusis, basi cuneatis, margine inconspicue serrulatis, supra glabris subtus consperse puberulis vel fere glabris, venis primariis utrinsecus \pm 8 oblique ascendentibus prope marginem furcatis supra distinctis, subtus prominulis, venulis laxae reticulatis utrinque manifestis non conspicuis; petiolo 1–1.5 cm. longo; inflorescentiis 4–5 cm. longis, fractis dense cinereo-pubescentibus, pilis brevibus \pm appressis; capitulis 5–7-floris; floribus basi bracteatis, bracteis 1–1.5 mm. longis, 1 mm. latis, oblongis obtusis; fructibus sessilibus pubescentibus, calycis lobis 1.5 mm. longis, 1 mm. latis, obtusis vel acutiusculis; filamentis 2 mm. longis; disco squamis \pm 0.3 mm. longis; ovario maturo 2 mm. diam., 1.5 mm. longo; stylis 3 mm. longis; semine levi subrotundato 1 mm. longo, 0.9 mm. lato, compresso.

NORTHEAST NEW GUINEA: above Samanzing, *Clemens* 8989, Oct. 1938, alt. \pm 1800 m., in mountain bush (tree 18 in. to 2 ft. diam.); Samanzing, *Clemens* 9068 (TYPE), Oct. 1938, alt. \pm 1800 m., (tree 2–3 ft. diam.); Samanzing vicinity, *Clemens* 9283A, Nov. 1938, alt. 1200–1800 m., in mountain bush (tree 10–12 in. diam.; flower buds yellowish green); Wantoat (Wantot), *Clemens* 10995, Jan. 1940, alt. 1050–1800 m. (tree 40–50 ft. high; flowers pale green-white).

The specimens *Clemens* 8989 and 9068 are in fruit. On some branchlets of the inflorescence where the fruits have already fallen the bracts are still on the axis. In the other two collections the flowers are in bud, but in *Clemens* 9283 the bracts subtending the minute flowers have already fallen. The leaves somewhat resemble those of *P. Versteeghii*, but are not fasciculate-barbate in the axils between the primary veins and the midrib, and the apex is mostly rounded; further, the inflorescences are not nearly so large or so copiously flowered.

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STUDIES IN THE THEACEAE XVIII THE WEST INDIAN SPECIES OF LAPLACEA

CLARENCE E. KOBUSKI

THE GENUS *Laplacea* was named by Humboldt, Bonpland and Kunth (1822) in honor of Marquis de [Pierre Simon] Laplace (1749–1827), a French mathematician and astronomer of the first order, and probably the ranking man of his time in these fields. Born the son of a small farmer in Beaumont-en-Auge in Normandy on March 28, 1749, Laplace owed his education to the interest shown in him by wealthy landowners. In 1767 he left Beaumont, where he had been teaching mathematics, and accepted the post of Professor of Mathematics at École Militaire in Paris. His *Mécanique céleste* (5 vols., 1799–1825) is considered today a monument of mathematical genius. His complete works were published by the French government in seven volumes (1843–47), and as late as 1912 a second edition containing additional matter was published.

A year earlier (1821) two other genera, *Wikstroemia* and *Lindleya*, were described by Schrader and Nees von Esenbeck respectively. These were named in honor of Dr. J. E. Wikström and the English botanist John Lindley (1799–1865).

A fourth name, *Haemocharis*, was very casually introduced by Salisbury in 1806 and taken up by Martius and Zuccarini in 1826.

Of the four names mentioned for the genus, *Laplacea* and *Haemocharis* received the greatest recognition. Considerable controversy, of a mild nature, resulted among adherents of all four generic names, but *Laplacea* and *Haemocharis* appealed most to the students of botany. Such workers as Humboldt, Bonpland and Kunth, DeCandolle, Sprengel, Cambessedes, Spach, Endlicher, G. Don, Walpers, Wawra, Melchior, Schmidt, and Lemée favored *Laplacea*, while Martius and Zuccarini, Choisy, Baillon, Kuntze, Szyszyłowicz, and Urban employed the name *Haemocharis*. Later Rehder pointed out that *Laplacea* appeared to be recognized by the majority of workers and suggested its retention as a *nomen conservandum*, and as such it appeared in Kew Bull. 1940: 112. 1940.

Blake (Contrib. Gray Herb. 53: 39. 1918) made a belated plea for *Wikstroemia*, the earliest name applied to the genus. He gave an excellent and very accurate review of the history of the genus. However, the name *Wikstroemia* could not be used, since it had already been placed on the list of *nomina conservanda* in 1905 as applying to a genus in a different family, the Thymelaeaceae.

Korthals, in 1842, described the genus *Closaschima*, which has since been reduced to synonymy under *Laplacea*. The study of the Asiatic material will not be included in this review but will be taken up later under a series of Asiatic studies.

The present study of the American species of *Laplacea* has been divided into two parts, the first including the West Indian species and the second those of South and Central America. This paper deals only with the West Indian species.

Of two species only, namely, *Laplacea haematoxylon* (Sw.) D. Don and *L. portoricensis* (Klug & Urban) Dyer, could one feel that material ample for complete and satisfactory study had been accumulated in the American herbaria. Of all the others the material is very sparse, in several instances the species having been collected only once or twice. Frequently great difficulty was experienced in preparing accounts of some earlier inadequately described species. In the genus as a whole the flowers are fairly large and conspicuous. Hence, often only a single flower was included with the collected specimen, and many times this single flower was incomplete. In such cases dissections of boiled material could not be made with a clear conscience, and it was necessary to employ great caution in working with the material so as not to ruin it for study by future workers.

As far as the West Indian species are concerned, no species have been reduced to synonymy in this study. In the province of Oriente, Cuba, five species and one variety are recognized. Oddly enough, the variety (new) has the most collected specimens. In the case of all the entities included here, very little material other than the original type was available for study. It is obvious that all are very closely related, and it is possible that future collections may prove that only two or perhaps three true species are represented. The same is true for the three species from Haiti.

An attempt has been made to bring together all the species of the genus, giving as complete descriptions as possible and supplying the synonymy and literature in each case. Brief discussions showing relationships between species and the outstanding characteristics helpful in identification have also been supplied.

The following abbreviations are used to designate the herbaria cited in this paper: A=Arnold Arboretum; Ch=Chicago Natural History Museum; G=Gray Herbarium; Mo=Missouri Botanical Garden; NY=New York Botanical Garden; and US=United States National Herbarium.

Laplacea Humboldt, Bonpland & Kunth, Nov. Gen. Sp. 5: 161 (207, ed. folio), t. 461. 1822. — DeCandolle, Prodr. 1: 527. 1824. — Sprengel, Syst. Veg. 2: 631. 1825. — Cambessedes in St. Hilaire, Fl. Bras. Merid. 1: 299. 1827. — Spach, Hist. Nat. Veg. 4: 76. 1835. — Endlicher, Gen. Pl. 1020. 1840. — G. Don, Gen. Syst. 1: 569. 1840. — Walpers, Repert. Bot. Syst. 1: 372. 1842; 2: 801. 1843; 7: 367. 1868. — Bentham & Hooker, Gen. Pl. 1: 186. 1862. — Wawra in Martius, Fl. Bras. 12(1): 287. 1886. — Melchior in Nat. Pflanzenfam. ed. 2, 21: 135. 1925. — O. C. Schmidt in Fedde, Rep. Spec. Nov. Reg. Veg. 29: 14. 1931. — Lemée, Dict. Pl. Phan. 3: 947. 1931. — Sprague et al. in Kew Bull. 1940: 112. 1940. — Marie-Victorin in Contrib. Inst. Bot. Univ. Montréal 49: 69. 1944. — Kobuski in Jour. Arnold Arb. 28: 435. 1947.

Wikstroemia Schrader in Götting. Gel. Anzeig. 1821(71): 710. May 5, 1821. — Pontin [Editor] in Vet. Akad. Handl. Stockholm 1821: 168. 1821, obs. in footnote. — Blake in Contrib. Gray Herb. n. s. 53: 36. 1918. — Urban, Fl. Ind. Occ. 8: 759. 1921.

Lindleya Nees in Flora 4: 299. May 21, 1821; op. cit. 328 (as syn. of *Wikstroemia*). June 7, 1821.

Haemocharis R. A. Salisbury, Paradisus Lond. 1: sub t. 56. 1806. — Martius & Zuccarini, Nov. Gen. Sp. 1: 106. 1826. — Choisy in Mém. Soc. Phys. Hist. Nat. Genève 1: 142 (Mém. Ternstr. 57). 1855. — Baillon, Hist. Pl. 4: 253. 1873. — O. Kuntze, Rev. Gen. Pl. 1: 62. 1891. — Szyzylowicz in Nat. Pflanzenfam. III. 6: 185. 1893. — Urban in Bot. Jahrb. 21: 545. 1896.

Closaschima Korthals, Verh. Nat. Gesch. Bot. ed. Temminck 139, t. 28. 1842.

Trees or shrubs. Leaves coriaceous, subcoriaceous or membranaceous, alternate, rarely asymmetrical, usually rounded or obtuse at the apex, often emarginate, tapering at the base into a short petiole, the margins denticulate or crenulate, rarely entire. Flowers solitary in the axils of the upper branches; bracteoles 2 (or more), sepaloïd, arranged along the peduncle, quickly caducous; sepals 5 (rarely more), thick-coriaceous, unequal, graduating in size and shape from bracteoles to petals, usually appressed-pubescent on the dorsal surface, deciduous or persistent; petals 5, rarely more, unequal, usually membranaceous, usually emarginate at the apex and occasionally pubescent on the dorsal surface, the outer petal often resembling the inner sepal; stamens many, seriate, the filaments adnate to the base of the petals, the anthers versatile; ovary basically 5-celled, occasionally 4-celled, rarely 6–10-celled, sericeous, the ovules 4 or more in each cell; the styles usually 5, occasionally 3 or 6, rarely 1, the stigmas usually the same in number as the styles, 5 when the style is solitary. Fruit an elongate, more or less woody, loculicidal capsule with persistent columella; seeds flat or compressed, drawn out into an oblong, membranaceous wing.

TYPE SPECIES: *Laplacea speciosa* HBK.

Urban, in one of his earlier works, in Bot. Jahrb. 21: 545–549. 1896, designated the flowers of *Laplacea* (under *Haemocharis*) as monoecious, and in all six of the species recorded (*L. Wrightii*, *L. Curtyana*, *L. haematoxylon*, *L. villosa*, *L. alpestris* and *L. portoricensis*) he carefully described both staminate and pistillate flowers. In this paper no reference has been made to monoecious flowers in either the generic or specific descriptions because no flowers were examined that were not hermaphroditic, according to my interpretation. If, in my study of the South and Central American species, I find material producing monoecious flowers, I will revise my generic description accordingly. It is interesting to note that in describing *L. cymatoneura* at a later date (1925), Urban made no mention of monoecious flowers. O. C. Schmidt reviewed the West Indian species of the genus *Laplacea* in 1931 and described *L. Samuelssonii* without designating staminate or pistillate flowers. Also in describing *L. Urbani* in 1925

Schmidt intimated that the flowers were hermaphroditic. Marie-Victorin (1944), who described the latest species (*L. moaensis*) attributed to the genus, found only hermaphroditic flowers.

As in most other genera of the Theaceae, the terminal leaf-bud in *Laplacea* appears to be the true criterion of pubescence. In some species the mature leaves may often appear glabrous, yet an examination of the leaf-bud will show that originally the leaves were appressed-pubescent, pilose or even villous. The only truly glabrous species in the West Indies is *L. Wrightii*.

The texture of the leaf is often very difficult to determine in the dried state. Seldom does one find a species with thin membranaceous leaves. The texture is such that when dried the leaf appears subcoriaceous, at least, even though the collector may have signified the texture to be membranaceous.

The apex of the leaf is usually obtuse or rounded, often retuse or emarginate. The base is usually long tapering, often very finely decurrent into a rather short petiole, which may appear longer on casual observation because of the deceptive decurrent base.

The margins are usually finely denticulate, often with a minute point at the end of the denticulation which is easily and often broken off. More rare are crenulate or entire margins.

The bracteoles, two or more in number, are as a rule quickly caducous. These may be distributed along the pedicel or close to the calyx. They are sepaloid in appearance and grade into the sepals. Like the sepals, they are usually subligneous and pubescent on the dorsal surface. The sepals themselves grade from the bracteoles into the outer petals. The inner sepals tend to have a more membranaceous margin and occasionally it is difficult to distinguish between the inner sepal and the outer petal. The inner petals are considerably larger than the sepals, white in color, thinner in texture, and usually deeply emarginate at the apex. Occasionally one may find the outer petal to be entire and narrower at the apex. Pubescence on the dorsal surface of the petals is common but to a lesser degree than is found on the sepals.

The stamens of the various species are quite similar, differing mostly in the length of the filament and the number of series. The ovary, always sericeous, offers little variation. The accepted number of cells is five, but occasionally there are four. *Laplacea portoricensis* is an extreme exception, having six to ten cells in the ovary.

The style offers considerable variation. In most species the styles number five with an individual stigma on each style. In *L. Samuelssonii* the styles number three, while in *L. benitoensis* the styles are joined in a single entire style which is topped by five stigmas. Usually the styles are erect. Exceptions are found in *L. alpestris* and *L. cymatoneura*, where the styles are horizontal and the stigmas considerably enlarged.

The capsule offers little variation. In most species the number of valves, corresponding with the number of cells in the ovary, is five. In *L. porto-*

ricensis the valves number six to ten. The surface of the capsule is usually appressed-pubescent or glabrescent, never, as far as I know, sericeous. The length of the capsule is usually more than two centimeters. In *L. alpestris* and *L. cymatoneura* the capsule measures approximately one centimeter.

KEY TO THE SPECIES

A. Terminal leaf-bud pubescent.

B. Ovary and fruit 4-5-celled.

C. Styles horizontal, the stigmas flattened and considerably dilated.

D. Leaves 1-1.5 cm. wide, long-pilose beneath; petals lightly pubescent on the dorsal surface. (Haiti). 1. *L. alpestris*.

DD. Leaves 2-2.5 cm. wide, glabrous beneath; petals glabrous on the dorsal surface. (Haiti; Dominican Republic)...
.....2. *L. cymatoneura*.

C. Styles erect, the stigmas not flattened and dilated as above.

D. Leaves linear-lanceolate or oblong-elliptic, acute at the apex, about five times longer than broad. (Cuba).....
.....4. *L. angustifolia*.

DD. Leaves obtuse or rounded at the apex, not linear-lanceolate or oblong-elliptic, seldom more than three times longer than broad.

E. Style entire, topped by several stigmas. (Cuba)....
.....6. *L. benitoensis*.

EE. Styles free to the base.

F. Styles 3 in number, ca. 0.6 mm. long. (Haiti)
.....3. *L. Samuelssonii*.

FF. Styles 5 in number, usually ca. 1 cm. long.

G. Leaf-margin crenate-undulate; upper pair of veins arching, first upward and out toward the margin, then back toward the midrib, appearing to join near the point of a deep emargination, forming a heart-shaped figure. (Cuba).....7. *L. Urbani*.

GG. Leaf-margin entire, denticulate or denticulate-crenulate; upper pair of veins not as above.

H. Petals 8-10 mm. long, approximately equaling the calyx-lobes in length; leaf-margin denticulate-crenulate along the upper half of one side of the margin, the other side entire; leaves often oblique. (Cuba).....8. *L. moaensis*.

HH. Petals 15-30 mm. long, always greatly exceeding the calyx-lobes; leaf-margins entire or denticulate along both sides; leaves symmetrical.

I. Leaf-margin entire; the under surface villous when young and clearly showing the original folds of the leaf. (Cuba)....10. *L. Curtyana*.

II. Leaf-margin denticulate; the under surface pubescent or glabrous but not showing the original folds of the leaf.

J. Branchlets and stems villous at maturity. (Jamaica)
.....11. *L. villosa*.

JJ. Branchlets and stems pubescent when very young, glabrescent at maturity.

K. Leaves chartaceous; petals glabrous or nearly so on the external surface; stamens 4-5-seriate; peduncles 2-5 mm. long. (Jamaica)
.....12. *L. haematoxylon*.

KK. Leaves coriaceous; petals pubescent on the external surface; stamens 3-seriate; peduncles ca. 1 mm. long. (Cuba)...9. *L. Ekmani*.

BB. Ovary and fruit 6-10-celled. (Porto Rico)...13. *L. portoricensis*.

AA. Terminal leaf-buds glabrous. (Cuba).....5. *L. Wrightii*.

1. *Laplacea alpestris* (Krug & Urban) Dyer in Index Kew. Suppl. 2: 86. 1904. — Melchior in Nat. Pflanzenfam. ed. 2, 21: 136. 1925. — O. C. Schmidt in Fedde, Rep. Spec. Nov. Reg. Veg. 29: 16. 1931. — Moscoso, Cat. Fl. Doming. 1: 377. 1943.

Haemocharis alpestris Krug & Urban in Bot. Jahrb. 21: 547. 1896. — Urban, Fl. Ind. Occ. 8: 436. 1920.

Wikstroemia alpestris (Krug & Urban) Blake in Contrib. Gray Herb. n. s. 53: 38. 1918. — Urban, Fl. Ind. Occ. 8: 759. 1921.

Small tree 2-3 m. high. Terminal leaf-bud gray-sericeous. Young branchlets long-pilose, the older branchlets glabrescent, strigose. Leaves chartaceous, elliptic to elliptic-obovate, 2.5-4 cm. long, 1-1.5 cm. wide, obtuse, rarely rounded at the apex, long-tapering at the base, glabrous, dark green above, long-pilose and lighter green beneath, the margin quite flat, occasionally subrevolute, finely denticulate especially toward the apex, the midrib slightly canaliculate above, the veins 8-10 pairs, conspicuous above, very outstanding below forming a sharp network over the entire lower surface, the petiole 2-4 mm. long. Flowers few, solitary, in axils near the apex of the branchlets; peduncles very brief, ca. 2 mm. long; bracteoles quickly caducous; sepals ca. 5, broadly ovate to subrotund, the larger ones 5-6 mm. long, pilose on the external surface; petals 5, obovate, ca. 15 mm. long, 8-10 mm. wide, unequal, deeply emarginate at the apex, pubescent on the median portion of the external surface; stamens bi-seriate, the filaments glabrous, 4-5 mm. long, the anthers subglobose, ca.

1 mm. long; ovary ovate, white-pilose, 4-5-celled, with ca. 3 ovules in each cell, the styles 4-5, horizontal, ca. 1 mm. long, glabrous except at the extreme base, the stigmas considerably dilated, semiorbicular. Capsule oblong, ca. 10 mm. long, 4-5 mm. diam., very short-appressed-pubescent, 4-5-celled, 2-3 seeds in each cell; seeds with wing ca. 7-8 mm. long, 2 mm. wide.

HAITI: Morne des Commissaires, Gros Cheval, alt. 1500 m., *L. R. Holdridge 1260* (US), June 9, 1942 (tree 10 m. tall; petals white, ca. 2 cm. long, deeply emarginate; old capsules persistent).—Morne des Commissaires, alt. 5800 ft., *J. T. Curtis s.n.* (US), July 24, 1944.—Massif de la Pelle, Marigot, Jardins Bois-Pin, alt. 1800-1900 m., *E. L. Ekman H1622* (US), Aug. 24, 1924.

Laplacea alpestris was the first species of the genus described from the republics of Haiti and Santo Domingo. Since then two more species, *L. Samuelssonii* Schmidt and *L. cymatoneura* Urban, have been described. Upon studying the genus as a whole one is struck by the close relationship of these three species, and the study of further collections may show *L. cymatoneura* to be, at the most, only a variety of *L. alpestris*.

Distinctive characters of this species are: (1) the horizontal styles and broadened stigmas; (2) the long-pilose hairs on the under surface of the mature leaves; (3) the petals pubescent on the dorsal surface; and (4) the fine, extensive and pronounced reticulation on the under surface of the leaves.

Laplacea Samuelssonii can be separated from this species by the styles which are three in number and erect and by the stigmas which are somewhat capitate but not broadened. Also the pubescence when present on the under surface of the leaves is appressed, rather than loose-pilose and turns dark in color.

Laplacea cymatoneura possesses the five horizontal styles and broadened stigmas and the pronounced reticulation on the under surface of the leaf. However, this reticulation is confined more to the outer half of the leaf. The under surface of the leaf is quite glabrous, as is the dorsal surface of the petals.

Krug and Urban, in their original description of *L. alpestris* and Urban in the description of *L. cymatoneura* describe in detail staminate and pistillate flowers. In all the flowers I examined or dissected there was no instance of sexual distinction in the individual flowers.

2. *Laplacea cymatoneura* Urban in Fedde, Rep. Spec. Nov. Reg. Veg. 20: 34. 1924. — O. C. Schmidt in Fedde, Rep. Spec. Nov. Reg. Veg. 29: 16. 1931; 33: 176. 1933. — Moscoso, Cat. Fl. Doming. 1: 377. 1943.

Large forest tree. Terminal leaf-bud appressed-pubescent, the branchlets of the current year's growth appressed-pubescent, glabrous when mature, erect, brown, terete, lightly striate. Leaves coriaceous, obovate, 4-5 cm. long, 2-2.5 cm. wide, obtuse or rounded at the apex, emarginate, cuneate at the base into a petiole 4-5 mm. long, dark green, shining, glabrous

above, lighter green, glabrescent below, pilose especially along the midrib and margin when young, the margin subrevolute appearing crenulate on the upper surface but distinctly denticulate on the under surface, the midrib deeply canaliculate on the upper surface, broad and prominent beneath, the veins 8–10 pairs, obvious above, very distinct below, nearly horizontal with the midrib, anastomosing near the margin forming a sharply defined network of lesser veins. Flower solitary, axillary near the ends of the branchlets; peduncles ca. 8 mm. long, appressed-pubescent; bracteoles quickly caducous, the scars prominent on the peduncle; sepals unequal, subrotund, the outer sepals 5–6 mm. long, 6–7 mm. wide, the inner ones larger, up to 10 mm. long, 9 mm. wide, appressed-pubescent on the dorsal surface; petals obovate, glabrous, deeply emarginate, up to 23 mm. long, 13 mm. wide; stamens 2-seriate, the filaments 2.5–3 mm. long, glabrous, the anthers minute, less than 0.5 mm. long, globular; ovary ovoid, sericeous, 5-celled, the cells 3-ovulate, the styles 5, horizontal, glabrous, ca. 0.5 mm. long, the stigmas expanding considerably beyond the styles. Capsules narrow-elliptic, ca. 1.5 cm. long, the seeds ca. 3 mm. long with the wing ca. 7 mm. long.

DOMINICAN REPUBLIC: Prov. Pacificador, vicinity of San Francisco de Macoris, Quita Espuela, alt. 400–1000 m., *W. L. Abbot 2093* (US, ISOTYPE), April 5–17, 1922 (large forest tree). HAITI: Massif du Nord, Port-de-Paix, Haut-Piton, on laterite, alt. ca. 800 m., *E. L. Ekman H3688* (US), April 6, 1925.

This species was described by Urban (1924) from very fragmentary material and is consequently incomplete. He stated that he had seen only two leaves. Knowing the variations that are frequently found in this family, it is surprising that he separated the species from *L. alpestris* (to which it is obviously closely related) on the basis of such scanty material. Abbot's isotype in the U. S. National Museum is very similar to the material seen by Urban. It consists merely of a packet containing two leaves and a few petals, and on the sheet a piece of wood which evidently came from a very large tree, as is stated on the label.

Later, in 1933, O. C. Schmidt amplified the description by including the fruit and by citing two more specimens, *Ekman H3688* and *H4635*. *Ekman H3688* is represented in the U. S. National Herbarium. Before seeing Schmidt's work I had difficulty in identifying *Ekman H3688*, finally deciding to place it with *L. cymatoneura*, even though the petals measured only 11 or 12 mm. in length and the veins rose less horizontally from the midrib. In the two leaves of the type the veins are strikingly horizontal. In *Ekman H3688*, although the majority of the veins appear to rise subhorizontally to the midrib, many leaves show veins which leave the midrib at an angle of 60° or even 45°. It is quite probable that Abbot's few leaves may have been collected from a tree which exhibited the same variation in veining as *Ekman H3688*. I was pleased to find that Schmidt reached the same conclusion as I regarding the Ekman specimen, although in his added description he did not mention the variations recorded above.

In his mention of *Ekman H4635*, a specimen which I have not seen, he described only the fruit.

This species can be separated from *L. Samuelssonii* by the horizontal styles, which number five. In *L. Samuelssonii* the styles are three in number and erect, and the stigmas are capitate rather than broadened.

From *L. alpestris* the species can be separated at present by the larger (wider) leaves and their glabrous under surface and by the glabrous dorsal surface of the petals. The leaves of *L. alpestris*, even in maturity, are distinctly long-pilose below, and narrower, with an over-all reticulation. The petals are lightly pubescent on the dorsal surface. In most characters, however, these two species agree. However, since small petals (11 or 12 mm.) have been found in *Ekman H3688*, it may eventually be necessary, on the basis of additional material, to combine the two species, recognizing this one as a variety of *L. alpestris*.

3. *Laplacea Samuelssonii* O. C. Schmidt in Fedde, Rep. Spec. Nov. Reg. Veg. 29: 16. 1931. — Moscoso, Cat. Fl. Doming. 1: 377. 1943.

Small tree. Terminal leaf-bud and young branchlets of the current year densely appressed-pilose, the older branchlets terete, glabrous, brown-gray. Leaves chartaceous, oblanceolate or narrowly obovate, 2–4 cm. long, 1–1.5 cm. wide, narrowed at the apex, rounded, occasionally emarginate, cuneate at the base, elongate-tapering at the extreme base into a very short petiole 1 mm. long, glabrous above, sparsely appressed, very short pubescent below, darkening with age and appearing black in the dried state, the margin subrevolute, finely denticulate, the veins 10–12 pairs, rather inconspicuous above, prominent below, rising nearly horizontally from the midrib, anastomosing near the margin, forming a narrow network of veins. Flowers solitary, axillary near the ends of the branchlets; peduncles short, 1–1.5 mm. long; bracteoles quickly caducous; sepals unequal, suborbicular, 5–7 mm. long, 7–8 mm. wide, appressed-pubescent on the dorsal surface; petals 5, white (*Ekman*), obovate, ca. 12 mm. long, 8–10 mm. wide near the apex, emarginate, lightly appressed-pubescent in the median portion of the external surface; stamens apparently tri-seriate, the filaments glabrous, unequal, those of the outer row 3 mm. long and those of the inner row ca. 4 mm. long, the anthers subglobose, ca. 0.8 mm. long; ovary subglobose, densely sericeous, 6-angled (*Schmidt*), the styles 3, thick, ca. 0.6 mm. long, erect, glabrous. Fruit not known.

HAITI: Massif des Matheux, l'Arcahaie, Morne Delpech, alt. ca. 4000 m., *E. L. Ekman 9320* (US, ISOTYPE), Nov. 14, 1927.

Two mounted sheets of *Ekman 9320*, the type of the species, are deposited in the U. S. National Herbarium. One specimen has leaves up to 4 cm. long and 1.5 cm. wide, while on the second specimen all the leaves are much smaller, none measuring more than 2 cm. long and 0.8 cm. wide. In other characters there is complete agreement.

Distinctive characters are: (1) the sharp reticulate veining on the under surface of the leaf; (2) the short scattered appressed pubescence (eventu-

ally darkening) on the under surface of the leaf; (3) the three erect, short styles; and (4) the tri-seriate stamens.

The species is closely allied to *L. alpestris* (Krug & Urban) Dyer and to *L. cymatoneura* Urban. It can be distinguished from *L. alpestris* by the three erect, very short (0.6 mm.) styles. In *L. alpestris* the styles number ca. 5 and lie horizontal to the ovary, and the stigmas are pronouncedly dilated. The leaves are noticeably much longer pilose on the under surface of the leaf, especially along the midrib.

4. *Laplacea angustifolia* (Britton & Wilson) O. C. Schmidt in Fedde, Rep. Spec. Nov. Reg. Veg. 22: 94. 1925. — Marie-Victorin in Contrib. Inst. Bot. Univ. Montréal 49: 70, 75. 1944.

Haemocharis angustifolia Britton & Wilson in Bull. Torrey Bot. Club. 50: 43. 1923.

Tree 20–30 m. Terminal leaf-bud slender, appressed-pubescent. Young branchlets slender, grayish brown, terete, appressed-pubescent, the older branchlets glabrous. Leaves coriaceous or subcoriaceous, oblong-elliptic to linear-lanceolate, 3–4 cm. long, 0.6–0.8 cm. wide (also 5.5–6 cm. long and 1.3–1.4 cm. wide), acute at the apex, not sharply so, finely apiculate, tapering gradually at the base into a petiole 1 mm. long, glabrous above, the younger leaves covered underneath with a light spreading pubescence, at maturity pubescent on the midrib only, the margin entire, subrevolute, the veins ca. 12 pairs, lightly elevated on both surfaces, anastomosing near the margin. Flowers solitary, axillary near the apices of the branchlets; peduncles very short, terete, 1 mm. long, appressed-pubescent; bracteoles 2, sepaloid, broadly ovate, 2–3 mm. long, appressed-pubescent on the external surface; calyx-lobes 5, suborbicular, 4.5–6 mm. long, 4–6 mm. wide, appressed-pubescent on the external surface; petals 5, obovate, 1.5–1.7 cm. long, ca. 1.3 cm. wide, deeply emarginate at the apex, pubescent on the median portion of the external surface; stamens bi-seriate, ca. 30, the filaments quite equal, filiform, ca. 5 mm. long, glabrous, the anthers subglobose, 0.5 mm. or less long; ovary globose, densely white-villous, 5-celled, the styles 5, distinct, glabrous, ca. 1 mm. long. Fruit not seen.

CUBA: Oriente: Pico Turquino, Maestra Ridge, alt. 1300 m., *Fr. Leon* 11072 (NY, TYPE), July 1922 (tree 20–30 m.). — Pico Turquino, slope of First Peak, *G. C. Bucher* 77 (NY), Oct. 12–14, 1924.

The narrow oblong-elliptic leaves of this species are its most distinctive feature. Closely resembling these leaves in appearance are those of the narrower-leaved specimens of *L. Wrightii* Grisebach. The terminal leaf-buds of the latter species are glabrous, whereas in this species they are pubescent.

5. *Laplacea Wrightii* Grisebach in Mem. Amer. Acad. n. s. 8: 166 (Pl. Wright.). 1860. — Walpers, Repert. Bot. Syst. 7: 367. 1868. — Sauvalle, Fl. Cuba. 10. 1873. — Melchior in Nat. Pflanzenfam. ed. 2, 21: 136. 1925. — O. C. Schmidt in Fedde, Rep. Spec. Nov. Reg. Veg. 29: 17. 1931. — Marie-Victorin in Contrib. Inst. Bot. Univ. Montréal 49: 70, 75. 1944.

Haemocharis Wrighti (Grisebach) Gomez de la Meza, Dicc. Bot. Nom. Vulg. Cub. Puerto Riq. 15. 1889; Ensayo Farm. Cuba 26. 1889; in Anal. Hist. Nat. Madrid 19: 222. 1890. — Urban in Bot. Jahrb. 21: 545. 1896. *Wikstroemia Wrightii* (Grisebach) Blake in Contrib. Gray Herb. n. s. 53: 41. 1918.

Slender tree. Terminal buds small, glabrous on the external surface. Branchlets glabrous (current year's growth appressed-pubescent), terete. Leaves coriaceous, obovate to obovate-elliptic, 5–9 cm. long, 2–3 cm. wide, glabrous on both surfaces, obtuse or rounded at the apex, usually lightly emarginate, tapering at the base into a short petiole 2–3 mm. long, the margin entire or rarely minutely serrulate toward the apex, the veins 8–12 pairs, quite inconspicuous on both surfaces. Flowers solitary, axillary: peduncles glabrous, 4–6 mm. long, terete; bracteoles caducous; sepals 5, ovate to orbicular, ca. 10 mm. long, sericeous on the external surface, appressed-pilose on the internal surface, shortly apiculate at the apex; petals 5, obovate, white, 15–17 mm. long, ca. 10 mm. wide, appressed-pubescent on the external surface; stamens ca. 50, the filaments bi-seriate, the anthers ovate; ovary 5-celled, densely sericeous, oval, few-ovulate. Capsule ovoid, obtuse at the apex, 2–3 cm. long, glabrescent, 5-angled, 5-celled; seeds (including wing) 12–15 mm. long.

CUBA: Oriente: near Monte Verde, in forest, *C. Wright 48* (ISOTYPES, G, NY, Mo), Jan.-July 1859 and 1860–1864 (slender tree with white flowers). — South of Sierra Moa, Camp La Gloria, *J. A. Shafer 8195* (NY, US), 8203 (NY, US), Dec. 24–30, 1910 (slender shrub 5 ft. high with white flowers).

The distinguishing characters are: (1) glabrous terminal leaf-buds; (2) coriaceous leaves; (3) large fruit and seeds; and (4) sepals pubescent on both the external and internal surfaces. The glabrous terminal buds distinguish this species from all other Cuban species.

From the Sierra Moa region of Oriente are two specimens, *J. A. Shafer 8195* and 8203, which probably belong here but possess neither fruit nor mature flowers. The leaves are more narrow (sometimes only a single centimeter wide) and resemble *L. angustifolia*. However, in the latter species the terminal buds are distinctly pubescent. I do not believe that this Shafer material should be given varietal status even though the leaf difference seems distinctive. Too little material has been examined.

Six sheets of "*Wright 48*" have been examined in this study. It is very obvious that this group of specimens does not comprise a single collection. There are four different labels with this number, all from Oriente:

1. "prope villam *Monte Verde* dictam, Cuba Orientali, Jan.-Jul. 1859." This is printed on a blue label with a written number 48. A blue field label accompanies the printed label and states that the habit is that of a slender tree and that the flowers are white. The abbreviation "M. V. Dec. 8" on this field label agrees in locality (M. V. standing for Monte Verde) but the date "Dec. 8" does not agree with the printed label. A single specimen is found at the Gray Herbarium.

2. "1856-7, in Cuba Orientali." Another single specimen with a blue label in the Gray Herbarium. Besides the number "48" is also found the number "64" both on the label and in a packet at the top of the sheet.

3. "Sept. 1859-Jan. 1860." This is on a white label with no further information. There are two sheets of this collection in the herbaria of the New York Botanical Garden and the Missouri Botanical Garden.

4. "1860-64." On a white label, and found at Gray, Missouri, and New York. The Gray specimen possesses an added field label which states that the specimen was collected at Cachillas de Baracoa on May 14, and that it was arborescent with white flowers. However, the Gray and Missouri specimens possess very mature fruits with no flowers, while the New York specimen possesses a few unattached flower-buds.

Fortunately, since this "number 48" is the type of the species, these specimens all truly belong to the same species. However, until the species is re-collected we cannot be sure of the true type-locality.

6. *Laplacea benitoensis* (Britton & Wilson) O. C. Schmidt in Fedde, Rep. Spec. Nov. Reg. Veg. 24: 78. 1927; 29: 16. 1931. — Marie-Victorin in Contrib. Inst. Bot. Univ. Montréal 49: 70, 75. 1944.

Haemocharis benitoensis Britton & Wilson in Mem. Torrey Bot. Club 16: 82. 1920.

Straggling shrub 1-3 m. high. Terminal leaf-bud small, ca. 5 mm. long, villous. Branches slender, terete, the very young branchlets appressed-pubescent. Leaves coriaceous, obovate, 3-5 cm. long, 1-1.6 cm. wide, rounded at the apex, cuneate at the base, glabrous, light green above, loosely appressed-pubescent beneath, glabrescent, the margin entire, revolute, the veins few (ca. 8) in number, occasionally evident on both surfaces, usually not conspicuous, the petiole slender, 5-7 mm. long, pubescent in the younger leaves. Flowers solitary, axillary near the tips of the branchlets; bracteoles quickly caducous; sepals 5, small, suborbicular, 3-4 mm. long and wide, appressed-pubescent on the external surface; petals (fide Britton & Wilson) 5, white, elliptic-obovate, 10 mm. long, 5-6 mm. wide; stamens 2- or 3-seriate, glabrous, the filaments unequal, ca. 2 mm. long, the anthers globular, minute, ca. 0.25 mm. long; ovary subglobose, covered with a dense white-silver pubescence, glabrous at the apex and tapering broadly into an entire glabrous style which is topped by several stigmas. Fruit not seen.

CUBA: Oriente: vicinity of Camp San Benito, west of camp, in thicket, alt. 900 m., *J. A. Shafer 4063* (NY, TYPE), Feb. 24, 1910 (straggling shrub 4 ft. high; flowers white). — South of Sierra Moa, Camp La Gloria, *J. A. Shafer 8208* (Ch, NY, US), 8272 (G, NY), Dec. 24-30, 1910 (shrub 6-10 ft.).

A few of the outstanding characteristics of this species are: (1) the small calyx-lobes and corolla-lobes; (2) the small pubescent terminal leaf-buds; (3) the very short peduncles; (4) the entire revolute margins of the small thick leaves; (5) the very small stamens; and (6) the entire style.

Although six specimens were available for this study, none offered mature flowers for dissection. Fortunately, the type specimen (*J. A. Shafer 4063*), deposited in the New York Botanical Garden, possessed remnants of a partially dissected flower, and it was from this and the diagnosis of the original authors that the above description was drawn up.

7. *Laplacea Urbani* O. C. Schmidt in Fedde, Rep. Spec. Nov. Reg. Veg. 22: 93. 1925; 29: 17. 1931. — Marie-Victorin in Contrib. Inst. Bot. Univ. Montréal 49: 70, 75. 1944.

Small tree. Terminal leaf-buds elongate, conspicuously gray-appressed-pubescent. Branches brown-gray, terete, glabrous, conspicuously marked by leaf-scars, the very young branchlets short-appressed-pubescent, quickly glabrous. Leaves disposed at the ends of the branchlets, obovate, 6–10 cm. long, 2.5–4 cm. wide, rounded and deeply emarginate at the apex, tapering at the base, glabrous above, appressed-pubescent below (on the midribs only in mature leaves), the margin crenate, nearly undulate, the veins prominent on both surfaces, ca. 15 pairs, branching and anastomosing near the margin appearing reticulate, the upper pair arching back and terminating near the deepest point of emargination, the actual petiole short, 3–4 mm. long, pubescent below. Flowers solitary, axillary, the peduncle 10–12 mm. long, terete, pubescent with a number of scars along the side, the scars probably those of the caducous bracteoles; sepals 5, obovate to rounded, sericeous-pubescent on the external surface, unequal, the outer ones 7–8 mm. long and ca. 6 mm. wide, the inner ones 9–12 mm. long, 6–8 mm. wide; petals 5 (fide Urban), white, obovate, 2.3–2.5 cm. long, 1.5–1.7 cm. wide, deeply emarginate at the apex, pubescent on the dorsal surface; stamens many, 3 (or more)-seriate, the filaments glabrous, somewhat unequal, 7–10 mm. long, the anthers oblong-elliptic ca. 1 mm. long; ovary ovoid, sericeous-pubescent, 2.5–3 mm. long, 5-celled; styles 5, 1–1.5 mm. long, glabrous; stigmas 5. Fruit not seen.

CUBA: Oriente, Sierra Maestra, Pinar de Caridad, southeast of Yara, pine patch at edge of brook, *E. L. Ekman 14687* (NY, ISOTYPE), July 31, 1922.

This species is characterized by large leaves, 6–10 cm. long, 2.5–4 cm. wide, rounded and deeply emarginate at the apex. The margin is very outstanding for the genus in that it is softly crenulate, without any evidence of glands. The veining also is distinctive. Conspicuous on both surfaces, the veins join about half-way to the margin, becoming reticulate. The upper pair arch upward, then back again toward the midrib, and appear to join near the point of emargination, forming a nearly heart-shaped figure. The complete arc is not always obvious or truly formed.

The corolla is deeply emarginate. The stamens are more numerous than those found in most species and appear to be 3- or 4-seriate. Along the peduncle were found scars caused by caducous bracteoles, farther spaced, however, than is usual, scattered over the entire length of the peduncle.

Several characters are mentioned above with an element of uncertainty. Only a single, partially dissected flower was attached to the specimen. No

attempt at boiling up the flower or dissections was made. The description was drawn up from that of the original author and supplemented by observations on the type whenever possible.

7a. *Laplacea Urbani* O. C. Schmidt var. *subserrulata*, var. nov.

A typo recedit foliis margine subserrulatis vel leviter crenulatis et apice minus profunde emarginatis vel integris.

CUBA: Oriente: Firmesa to Gran Piedra, *J. A. Shafer* 8974 (NY, US), Mar. 4-5, 1911 (shrub 8 ft.).—Range of Sierra Maestra, Loma del Gato, alt. 900-1000 m., *Fr. Leon, Clement & M. Roca* 9858 (NY, TYPE), 10015 (NY), July 11-Aug. 14, 1921 (small tree 5-6 m.).—Cobre range of Sierra Maestra, Loma del Gato, *Fr. Leon, Clement & M. Roca* 10125 (NY), July 11-Aug. 14, 1921 (shrub 4-5 m.).

The material cited above, like most of the earlier collections, has long been identified with *Laplacea Curtyana*, a species of western Cuba. Although it appears to resemble *L. Curtyana* in many respects, I feel that its true relationship is with one of the Oriente species, namely, *L. Urbani*. Any one of three species, *L. Urbani*, *L. Ekmani*, and *L. moaensis*, might well be the type from which this variety has derived. However, in *L. moaensis* the leaves have a tendency toward obliqueness and in *L. Ekmani* the leaves are coriaceous, both characters strong for any species of this group but lacking in this variety.

From typical *L. Urbani* the variety differs in the apex, margin, and venation of the leaf. Otherwise the two entities are very similar. At the apex of the leaf in the species a deep and very marked emargination is found, the margin is decidedly crenate, and the top pair of veins turn back to the midrib to form a heart-shaped figure. In the variety the apex of the leaf may be slightly emarginate or entire, the margin may be lightly crenulate, but usually is subserrulate, and the upper pair of veins do not turn back toward the midrib.

This variety differs nearly as much from the species as do *L. Urbani*, *L. Ekmani*, and *L. moaensis* from one another. Only four specimens were available for study of the three species listed above: two for *L. Ekmani* and one each for *L. Urbani* and *L. moaensis*. As many specimens were available for this variety alone.

8. *Laplacea moaensis* Marie-Victorin in Contrib. Inst. Bot. Univ. Montréal 49: 72. 1944.

Tree 3-5 m. high. Terminal leaf-bud with a fulvous or silvery appressed pubescence. Branchlets terete, reddish brown, pubescent when young, soon becoming glabrous. Leaves disposed at the ends of the branchlets, chartaceous, obovate or oblanceolate, 6-12 cm. long, 2-3.5 cm. wide, obtuse and slightly emarginate at the apex, narrowed at the base, glabrous above, fulvous-pubescent beneath, especially on the lower portion of the prominent midrib, the margin subrevolute, lightly denticulate-crenulate along one side especially toward the apex, entire along the other side, the veins (20-30 pairs) inconspicuous, the petiole very short, ca. 2 mm. long. Flowers solitary, axillary; peduncle short, ca. 6 mm. long, with bracteole scars dis-

posed along the sides, appressed-pubescent; bracteoles quickly caducous (not seen); sepals subrotund, unequal, 8–10 mm. long, nearly as wide, appressed-pubescent over the entire external surface; petals (fide Marie-Victorin) white within, slightly purple without, 8–10 mm. long; stamens with the filaments (ca. 10 mm. long) gradually attenuated from the base to the apex; ovary subspherical, 3–4 mm. long, white-sericeous-pubescent, 4–5-celled. Capsule oblong-elliptic, 2.5–3 cm. long, 4–5-celled; seeds dark-colored, glabrous, ca. 6 mm. long, with wing about 18 mm. long.

CUBA: Oriente: "Region de Moa, chemin des hauteurs à l'ouest du rio Cayoguan, sur la limonite argileuse recouvrant la serpentine," Marie-Victorin, Clément & Alain 21630 (G, ISOTYPE), April 16–23, 1943.

Laplacea moaensis, the most recent species of the genus, has been amply described and illustrated by Marie-Victorin in Contrib. Inst. Bot. Univ. Montréal 49: 69–75, figs 1 and 2, 1944. Although an isotype of the species was available for this study, no mature flowers or fruit were to be had for dissection; hence much of the above description was drawn from that of Marie-Victorin.

Coming from the serpentine region of Moa in the state of Oriente, like many other novelties from the same area it appears quite distinct. The peduncles are short (ca. 6 mm. long) and the bracteole-scars are found only along the upper half of the peduncle. The veins, although quite inconspicuous, are more numerous (20–30 pairs) than those in most other species of the genus. The margin is subrevolute. Along one side of the leaf the margin is entire, while along the other half a light crenulation can be found toward the apex. This margin condition, although not especially rare in the family, is distinctive for the genus.

A fine reddish dust from the serpentine region overlies most of the specimen, giving a brownish red color to the branchlets, midrib of the leaf, etc., and may be mistaken for a specific character. This dust can easily be wiped off with a cloth.

9. *Laplacea Ekmani* O. C. Schmidt in Fedde, Rep. Spec. Nov. Reg. Veg. 22: 94. 1925; 29: 17. 1931. — Marie-Victorin in Contrib. Inst. Bot. Univ. Montréal 49: 70, 75. 1944.

Small tree. Terminal leaf-bud silver-white sericeous-pubescent, ca. 6 mm. long. Young branchlets appressed-pubescent, glabrous when older. Leaves coriaceous, obovate, 4–8 cm. long, 2.3–3.5 (–4.5) cm. wide, rounded at the apex, tapering at the base, glabrous above, appressed-pubescent on the midrib below, also occasionally under the revolute margin, inconspicuously denticulate with slight evidences of glandular teeth (on the upper denticulations), the veins inconspicuous on both surfaces, ca. 12 pairs, the petiole short, 4–5 mm. long. Flowers axillary, solitary; peduncle ca. 1 cm. long, terete, appressed-pubescent; bracteoles several, disposed along the peduncle, quickly caducous, broadly ovate to rounded, the outer ones ca. 7 mm. long, sericeous-pubescent on the exterior surface, gradating in size into the sepals; sepals ovate, ca. 10 mm. long, 6–7 mm. wide, sericeous-pubescent on the exterior surface; petals (bud) pubescent on the exterior

surface; stamens (bud) 3-seriate, the filaments glabrous, the anthers subglobose; ovary (bud) subconical, densely silvery sericeous-pubescent, 5 (or 6)-celled, tapering at the apex into 5 (or 6) styles. Capsule oblong, 2.5–2.8 cm. long, glabrescent, 5 (or 6)-celled, each locule with ca. 5 seeds; seeds ca. 5 mm. long with the wing 10–12 mm. long.

CUBA: Oriente: Sierra de Nipa, Woodfred, in forest bordering on pinelands, on left side of Arroya del Medio, *E. L. Ekman 15283* (NY, ISO-TYPE), Sept. 25, 1922 (small tree).—Palmarito de Cauto, *A. Cuebelo 6230* (NY), June 2, 1932 (high tree).

This species was described from a fruiting specimen (*Ekman 15283*), a duplicate of which was available for this study. A second specimen (*Cuebelo 6230*), collected in the same general region as the type, possessed buds only, and these were very young. Dissections of the buds furnished only general information, but added somewhat to the original diagnosis of Schmidt.

The species appears to be most closely allied to *L. Urbani* Schmidt, differing mostly in the leaves, which are definitely coriaceous, not chartaceous as originally described. They are rounded at the apex and only rarely even slightly emarginate, not deeply so as is the case in *L. Urbani*. Also the leaf-margin is revolute, with hairs protruding from beneath the revolute portion of the margin. A very slight denticulation occurs along this margin. In *L. Urbani* the leaves are more nearly chartaceous, the margin distinctively crenate, and the pubescence on the mature leaves is confined to the midrib of the lower surface.

10. *Laplacea Curtyana* A. Richard, Ess. Fl. Cuba 1: (in Sagra, Hist. Ile Cuba 2:) 225. 1845. — Walpers, Repert. Bot. Syst. 5: 132. 1846. — Sauvalle, Fl. Cuba. 10. 1873. — Melchior in Nat. Pflanzenfam. ed. 2, 21: 136. 1925. — O. C. Schmidt in Fedde, Rep. Spec. Nov. Reg. Veg. 29: 17. 1931. — Marie-Victorin in Contrib. Inst. Bot. Univ. Montréal 49: 75. 1944.

Haemocharis Curtyana (A. Richard) Maza, Dicc. Bot. Nom. Vulg. Cub. Puerto-Riq. 15. 1889; Ens. Farm. Cuba 26. 1889; in Anal. Hist. Nat. Madrid 19: 222. 1890; in Estac. Exp. Agron. Cuba Bol. (Fl. Cuba) 22: 74. 1914. — Kuntze Rev. Gen. Pl. 1: 62. 1891, as *H. Courtyana*. — Urban in Bot. Jahrb. 21: 546. 1896. — Millspaugh in Field Columb. Mus. Bot. 1: 430. 1900.

Laplacea Courtyana Kuntze, Rev. Gen. Pl. 1: 62. 1891.

Wikstroemia Curtyana (A. Richard) Blake in Contrib. Gray Herb. n. s. 53: 39. 1918.

Tree up to 15 m. high. Terminal leaf-buds elongate, 1–1.5 cm. long, densely pubescent. Branches terete, pubescent when very young, later glabrous. Leaves coriaceous or subcoriaceous, elliptic to obovate, 6–8 cm. long, 2.3–3 cm. wide (occasionally up to 10×3.8 cm.), obtuse or subobtusate at the apex, tapering toward the base, glabrous and shining above (occasionally pubescent at base of midrib), pubescent below, glabrescent, the margin entire or subentire, the veins 12–15 pairs, curving upward near

the margin, the petiole short, 4–7 mm. long, pubescent. Flowers solitary; peduncle thick, terete, ca. 2 mm. long, pubescent; bracteoles 2, quickly caducous, when present unequal, the outer one smaller, broadly ovate, ca. 4 mm. long, 3.5 mm. wide, the inner one subrotund, ca. 5 mm. long and wide, both appressed-pubescent on the external surface; calyx-lobes 5, imbricate, very unequal in size and shape, outer lobes subrotund 6–8 mm. long, 6–7 mm. wide, the inner lobes increasing in both length and width, the innermost lobe broadly obovate to subrotund, ca. 18 mm. long, 10 mm. wide, with a wide membranaceous margin, very slightly emarginate, all appressed-pubescent on the dorsal surface; petals 5, unequal, the outer one obovate, the smallest 1.5 cm. long and 1.3 cm. wide, only slightly emarginate at the apex, the inner four more nearly equal, obovate to obcordate, ca. 2.2 cm. long and 1.5 cm. wide, deeply emarginate at the apex, all lightly pubescent on the external surface at least at point of emargination; stamens bi-seriate, ca. 40, the filaments of about equal length, free, glabrous, 5–6 mm. long, the anthers subglobose, ca. 1.5 mm. long; ovary semi-globose, densely white pubescent, 5-ribbed, 5-celled, tapering abruptly at the apex into fine short glabrous styles with 5 stigmas. Fruit woody ovoid, 5-ribbed, ca. 2 cm. long, 1 cm. wide, glabrous except within the ridges, the seeds with wings ca. 1.5 cm. long, the wing 9–10 mm. long.

CUBA: Isle of Pines: vicinity of Los Indios, arroya, *N. L. Britton, E. G. Britton & P. Wilson 14247* (Ch, G, Mo, NY, US), Feb. 13, 1916 (tree 15 m., flowers white).—No definite locality, *José Blain 22* (Ch). “Western Cuba”: “prope Vuelta de Abajo,” *C. Wright 2109* (G, Mo, NY, US), April 2, 1865.

Laplacea Curtyana is the first species described from Cuba and as such has been much confused and recorded over a range far too extensive. According to this study it is confined to the western part of Cuba and the Isle of Pines.

The species does not possess what might be termed truly outstanding characteristics. Some of the better characters to help in determination are: (1) the elongated, narrow, densely pubescent terminal leaf-bud; (2) the pubescence in waves (parallel to the margin) of density on the lower surface of the leaf; and (3) the entire or nearly entire margin of the leaf.

The specimens of *L. Curtyana* offered a good opportunity to observe the gradual change in form from the outer bracteole to the inner corolla-lobe. The inner calyx-lobe resembles very much the outer corolla-lobe. All the corolla-lobes except the outer one are deeply emarginate. The outer lobe is only slightly so.

Of the specimens cited above no locality was given on the sheet, *Wright 2109*. The quotation “prope Vuelta de Abajo” given in the citation above was taken from Urban’s publication.

11. *Laplacea villosa* (Macfadyen) Grisebach, Fl. Brit. W. Ind. 104. 1859. — Walpers, Repert. Bot. Syst. 7: 367. 1868. — Fawcett, Fl. Pl. Jamaica 3. 1893. — Melchior in Nat. Pflanzenfam. ed. 2, 21: 136.

1925. — Fawcett & Rendle, Fl. Jamaica 5(3): 188. 1926. — Schmidt in Fedde, Rep. Spec. Nov. Reg. Veg. 29: 16. 1931.

Gordonia villosa Macfadyen, Fl. Jamaica 1: 117. 1837. — Walpers, Repert. Bot. Syst. 1: 375. 1842.

Haemocharis villosa (Macfadyen) Choisy in Mém. Soc. Phys. Hist. Nat. Genève 1: 144 (Mém. Ternstr. 56). 1855. — O. Kuntze, Rev. Gen. Pl. 1: 62. 1891. — Urban in Bot. Jahrb. 21: 547. 1896.

Laplacea viscosa Hooker & Jackson, Index Kew. 2: 30. 1894, *lapsu*.

Wikstroemia Macfadyenii Blake in Contrib. Gray Herb. n. s. 53: 40. 1918.

Shrub 1.5–3 m. Terminal bud tawny-villous, the young branchlets terete, villous. Leaves coriaceous, pilose beneath, especially along the midrib, obovate, 7–10 cm. long, 3.5–5 cm. wide, obtuse or rounded at the apex, occasionally very short and bluntly acuminate, broadly cuneate at the base, appearing subauriculate, the margin revolute and crenulate, the midrib canaliculate above, raised below, widening toward the base, the veins 8–10 pairs, rather unobtrusive, the petiole thick, 1–3 mm. long, densely pilose on the under surface. Flowers solitary in the upper axils of the leaves; peduncles stout, 5–8 mm. long, pilose; bracteoles quickly caducous; sepals 5, imbricate, deeply concave, rounded, ca. 1.5 cm. long, 1.0–1.7 cm. wide, villous-sericeous, deciduous; petals 5⁺, obovate, 17–20 mm. long, 10–12 mm. wide, emarginate, pubescent on the external surface; stamens very numerous, pluri-seriate, the filaments unequal, up to 9 mm. long, the anthers oval, 2–2.5 mm. long; ovary villous-sericeous, 5-celled, the loculi 6–7-ovulate, the styles 5, glabrous, ca. 1 mm. or less long. Capsule subligneous, oblong, 2–2.5 cm. long, 1 cm. diam., obtuse, 5-angled at the apex, the seeds “5 in each cell.”

JAMAICA: Newhouse Gap, *J. Hart* 987 (NY, US), 1886. — Locality indefinite, *J. Hart* 351 (US). — Locality indefinite, *Macfadyen s. n.* (G).

This second species from Jamaica, although quite distinct from *L. haematoxylon* (Swartz) G. Don, has been less collected and is not known as well. A comparison of the two species can be found under the latter.

The size of the petals is probably recorded for the first time above. The dissection from boiled material shows them to be considerably smaller than those of *L. haematoxylon* and much less showy.

12. *Laplacea haematoxylon* (Swartz) G. Don, Gen. Syst. 1: 569. 1840. — Grisebach, Fl. Brit. W. Indies, 104. 1859. — Fawcett, Fl. Pl. Jamaica 3. 1893. — Melchior in Nat. Pflanzenfam. ed. 2, 21: 136. 1925. — Fawcett & Rendle, Fl. Jamaica 5(3): 188, fig. 72. 1926. — Schmidt in Fedde, Rep. Spec. Nov. Reg. Veg. 29: 17. 1931.

Gordonia haematoxylon Swartz, Fl. Ind. Occ. 2: 1199. 1800. — Lunan, Hort. Jam. 1: 461. 1814. — DeCandolle, Prodr. 1: 528. 1824. — Macfadyen, Fl. Jamaica 116. 1837.

Haemocharis haematoxylon (Swartz) Choisy in Mém. Soc. Phys. Hist. Nat. Genève 1: 144 (Mém. Ternstr. 56). 1855. — O. Kuntze, Rev. Gen. Pl. 1: 62. 1891. — Szyszylowicz in Nat. Pflanzenfam. III. 6: 185. 1893. — Urban in Bot. Jahrb. 21: 546. 1896.

Wikstroemia haematoxylon (Swartz) Blake in Contrib. Gray Herb. n. s. 53: 40. 1918.

Tree 10–15 m. high. Terminal buds hirsute. Young branchlets pubescent. Leaves membranaceous to subcoriaceous, ovate to elliptic, 5–10 cm. long, 2.5–4 cm. wide, obtuse or obtusely acuminate at the apex, narrowed at the base into a petiole 4–8 mm. long, the margin serrate or crenate-serrate, especially along the upper half, generally glabrescent with inconspicuous hairs along the under side of the petiole and the midrib, the veins rather obscure, 10–12 pairs. Flowers large, solitary in the upper axils, white, ca. 4–6 cm. in diameter when open, ca. 0.6 cm. in diam. in bud; peduncles stout, 2–5 mm. long, puberulent; bracteoles apparently 2, quickly caducous, sepaloid; sepals 5, imbricate, rounded, concave, lightly puberulous on the outer surface, unequal, varying in size from bracteoles to petals, ca. 1 cm. long, 1.2 cm. wide, the margin scarious; petals 5–8, white, obovate, unequal, 2–3 cm. long, varying in width 1–2 cm. on the same flower, the wider petals deeply emarginate, the narrow petals often entire at the apex, subglabrous; stamens apparently 4- or 5-seriate, the filaments glabrous, unequal, the outer row ca. 5 mm. long, connate for various short distances at the base, very rarely joined the entire length, the inner filaments ca. 9 mm. long, not joined, the anthers subrotund, ca. 1 mm. across; ovary globose, hirsute, 5-celled, few-ovulate, styles 5, glabrous, very short, 1 mm. or less long, channeled, spreading at the apex into the stigmas. Capsule woody, oblong, subpentagonal, pubescent, ca. 2 cm. long, 1 cm. or less in diameter, the seeds ca. 3 in each cell, the wing and seed 8–12 mm. long.

JAMAICA: eastern slope of John Crow Mts., woodlands, alt. 520 m., *N. L. Britton* 4162 (NY), Mar. 9–11, 1909 (tree 12 m. high; petals white). — Vinegar Hill, alt. 1100 m., *W. Harris* 5493 (Ch, NY, US), Nov. 21, 1894 (tree 15 ft. high). — Near Woodcutters Gap, alt. 1450 m., *W. Harris* 6736 (A, Ch, US), Nov. 6, 1896 (tree 5 m. high). — Hardware Gap, alt. 1350 m., *W. Harris* 10124 (Ch, NY, US), Feb. 19, 1908 (tree 50 ft. high; flowers white). — Tom's River Wood, Upper Clarendon, alt. 800 m., *W. Harris* 10852 (Ch, NY, US), Mar. 1, 1910 (tree 40 ft. high; flowers white). — John Crow Mts., alt. 600 m., *W. Harris & N. L. Britton* 10763 (Ch, NY, US), Mar. 10, 1909 (tree 36 ft. high; corolla pure white). — Blue Mts., Marces Gap, alt. 1650 m., *J. R. Perkins* 1469 (G), Mar. 31, 1916. — Blue Mts. near Marces Gap, alt. 1600 m., *A. Rehder s. n.* (A), Feb. 10, 1903. — Marces Gap, *F. Shreve s. n.* (NY), Feb. 7, 1906. — Indefinite locality, *J. Hart* 609 (Ch, US), 1886.

Described under *Gordonia* in 1800, this is the oldest species in the genus. It was referred to *Laplacea* by G. Don in 1840.

Some of the salient characters of the species are: (1) large white flowers, 4–6 cm. across, the petals glabrous or nearly so, the wider petals emarginate at the apex and the narrower petals entire, and (2) the leaves ovate or elliptic, 5–10 cm. long, quite glabrous beneath with occasional scattered pubescence along the lower midrib.

A closely related species, also from Jamaica, is *L. villosa*. The latter species is characterized by a villous pubescence on most of the parts (branchlets, lower surface of the leaves, pedicel, calyx-lobes, and external surface of the corolla). The leaves are obovate, rounded or bluntly acuminate at the apex, and broadly cuneate at the base, appearing subauriculate.

13. *Laplacea portoricensis* (Krug & Urban) Dyer in Index Kew. Suppl. 2: 86. 1904. — Melchior in Nat. Pflanzenfam. ed. 2, 21: 136. 1925. — O. C. Schmidt in Fedde, Rep. Spec. Nov. Reg. Veg. 29: 17. 1931.

Haemocharis portoricensis Krug & Urban in Bot. Jahrb. 21: 548. 1896. — Urban, Fl. Ind. Occ. 4: 411. 1910. — Britton & Wilson, Sci. Surv. Porto Rico & Virgin Isl. 5: 582. 1924. — L. R. Holdridge in U. S. D. A. For. Serv. Occ. Pap. (Trees Puerto Rico 2), 2: 53, fig. 1942.

Wikstroemia portoricensis (Krug & Urban) Blake in Contrib. Gray Herb. n. s. 53: 40. 1918.

Tree 5–20 m. high with gray, fissured bark. Terminal leaf-bud appressed-pubescent, elongate. Younger branchlets finely appressed-pubescent, the older branchlets becoming glabrous. Leaves chartaceous or subchartaceous, elliptic to obovate, 5–12 cm. long, 2.5–4.5 cm. wide, obtuse to rounded at the apex, occasionally slightly emarginate, long-tapering at the base, glabrous above, glabrescent (rarely appressed-pubescent) below, the margin crenulate along the upper half, entire along the lower portion, the midrib canaliculate above, the veins 15–20 pairs, rather inconspicuous above, prominent below, anastomosing near the margin and becoming reticulate, the petiole 2–5 mm. long. Flowers solitary near the apex, axillary; peduncle short, 1–4 mm. long, appressed-pubescent; bracteoles quickly caducous; sepals unequal, the larger or inner sepals suborbicular, 10–12 mm. long, sericeous on the external surface; petals 6–9, white, obovate, unequal, 18–22 mm. long, 15–18 mm. wide, some deeply emarginate at the apex, others rounded, glabrous on the external surface, the outer petals thickened in the medial area; stamens 3–4-seriate, many (over 100), the filaments glabrous, unequal, 5–7 mm. long, the anthers ovate to subglobose, ca. 1 mm. long; ovary globose, white-tomentose, 6–10-celled, tapering at the apex into the 5 or more glabrous styles, the stigmas recurved, reniform. Capsule woody, narrow-ovate, 15–25 mm. long, ca. 10 mm. diam., short-appressed-pubescent to glabrescent, 6–10-celled; seeds 4 or 5 in each cell, 10–13 mm. long with wings.

PORTO RICO: El Yunque, *F. H. Sargent* 541 (US), July 4, 1938 (tree). — Catalina-Yunque Trail, Luquillo Mts., in forest, alt. 600–850 m., *N. L. Britton & E. M. Bruner* 7579 (NY, US), 7604 (NY), Feb. 23–26, 1923 (tree 10 m. high; petals white, fugacious). — Jajoma Alta, *W. E. Hess* 5591 (NY), Dec. 3, 1913. — Sierra de Naguabo, Loma Icacó, edge of woods, alt. 210–675 m., *J. A. Shafer* 3426 (NY, US), July 24, 1914 (tree 30 ft. high; corolla white). — Sierra de Naguabo, Rio Icacó and adjacent hills, forest, alt. 465–720 m., *J. A. Shafer* 3517 (G, Mo, NY, US), July 30–Aug. 5, 1914 (tree 25 ft. high). — Sierra de Naguabo, Barrio de Maizales, mountain forest, alt. 900 m., *N. L. Britton & W. E. Hess* 2277 (Ch, G, NY, US), March

9, 1914 (tree 15 m. high; flowers white, 4 cm. wide). — Sierra de Luquillo, Jimenez, in mountain forest, *P. Sintenis* 1326 (Ch, G, Mo, NY, US), May 26, 1885. — Sierra de Naguabo, in primary forest, *P. Sintenis* 5318 (Ch, G, Mo, NY, US), Nov. 5, 1886. — Coco Valley, Maricao Verde, *L. E. Gregory* 57 (NY), Aug. 2, 1940 (tree 14 ft. high). — Indefinite locality, *A. A. Heller s. n.* (Ch, NY), 1910.

Of the above cited specimens, *Sintenis* 1326 and 5318 and *Heller s. n.* were cited by Krug & Urban in the original publication of this species. No specimen was designated as the type. Krug & Urban carefully distinguished between pistillate and staminate flowers. I sought both types but was unsuccessful in finding any that could be designated as either pistillate or staminate. The flowers dissected for this study possessed not only developed ovary, style, and stigma, but also anthers (over 100) which had produced pollen. Krug & Urban state that in the staminate flowers the stamens were 3–4-seriate, the filaments 5–7 mm. long, the styles 1.5 mm. long, and the stigmas scarcely evolute. The pistillate flowers were described as having filaments 4 mm. long and the anthers without pollen. The styles were designated as 2.5–3 mm. long, and the stigmas as reniform, recurved. The individual flowers which I examined possessed all the fertile characters listed by these authors.

Some of the distinctive characters of this species are: (1) the pubescent terminal leaf-bud; (2) chartaceous leaves with prominent veins (15–20 pairs) underneath, which anastomose near the margin and form a conspicuous network near the margin; (3) the 6–10-celled ovary and fruit with 5 or 6 styles; (4) glabrous petals, emarginate or obtuse at the apex, thickened at the median portion; and (5) the very numerous stamens 3–4-seriate. Another leaf-character, usually present, which is distinctive, is a pair of lines midway between the midrib and the margin and somewhat parallel to the margins of the leaves. This probably is caused by the folds of the leaf in the bud. In some species of other genera of the Theaceae, especially in species with a noticeable pubescence on the under surface, this character is more pronounced because of a heavier growth of pubescence along this line. Other species exhibit more than a single pair of lines.

According to L. R. Holdridge (loc. cit.) this species is restricted to the eastern mountains of Porto Rico above 300 m. in elevation. So far as is known, *L. portoricensis* is the sole representative of the genus in Porto Rico. Vernacular names are *Maricao verde* and *Maricao*.

ARNOLD ARBORETUM,

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THE MORPHOLOGY AND RELATIONSHIPS OF
CERCIDIPHYLLUM

B. G. L. SWAMY AND I. W. BAILEY

With two plates and eight text-figures

INTRODUCTION

OF THE FIVE FORMERLY ASSOCIATED GENERA, *Trochodendron*, *Tetracentron*, *Euptelea*, *Cercidiphyllum* and *Eucommia*, the first three have recently been thoroughly re-investigated by A. C. Smith (29, 30), Bailey and Nast (3) and Nast and Bailey (24, 25). The totality of evidence from all organs and parts of these plants indicates that, although the vesselless genera *Trochodendron* and *Tetracentron* are related, they exhibit no close affinities either to *Euptelea* or to the Magnoliaceae (*sensu stricto*), Winteraceae, Illiciaceae, or Schisandraceae.

There has been much speculation regarding the relationships of *Cercidiphyllum*, and it is desirable that this genus also be re-examined from a broad morphological point of view.

LEAF: EXTERNAL FORM

One of the most conspicuous characteristics of *Cercidiphyllum japonicum* Sieb. et Zucc. is its dimorphic foliage, *Fig. 1*. The broadly cordate or reniform, palmately veined leaves with crenate margins, that are referred to in the generic name as Cercis-like, are borne on short shoots. On the contrary, the long shoots of the current year's growth bear leaves which fluctuate from elliptic to deltoid to broadly ovate and have entire or finely rounded-serrate margins. In leaves of the short shoots (*d-i*), the primary veins diverge from a single locus at the base of the leaf, whereas in leaves of the long shoots (*j-p*), they frequently diverge in pairs at successive levels. Although both kinds of leaves fluctuate considerably in size, the ranges of variability in form, venation, and character of the margin are much wider in the case of the leaves of the long shoots than in those of the short shoots. The leaves of seedlings have fewer marginal glands and therefore fewer and relatively much coarser appearing crenulations (*b-c*). The cotyledons are oblong-obtuse with entire margins (*a*).

Brown (5) has performed a highly significant paleobotanical task in re-investigating fossil floras and in demonstrating by the occurrence of associated fruits, seeds and leaves that *Cercidiphyllum* was widely distributed in the Northern Hemisphere during the Upper Cretaceous and Tertiary. The fossil leaves had previously been assigned to twenty-one different genera, including *Boehmeria*, *Ceanothus*, *Cercis*, *Cissus*, *Dombeyopsis*, *Ficus*, *Grewia*, *Hakea*, *Hedera*, *Paliurus*, *Piper*, *Populus*, *Smilax*, *Viburnum*, and *Zizyphus*, and the fruits and seeds to suggested relation-

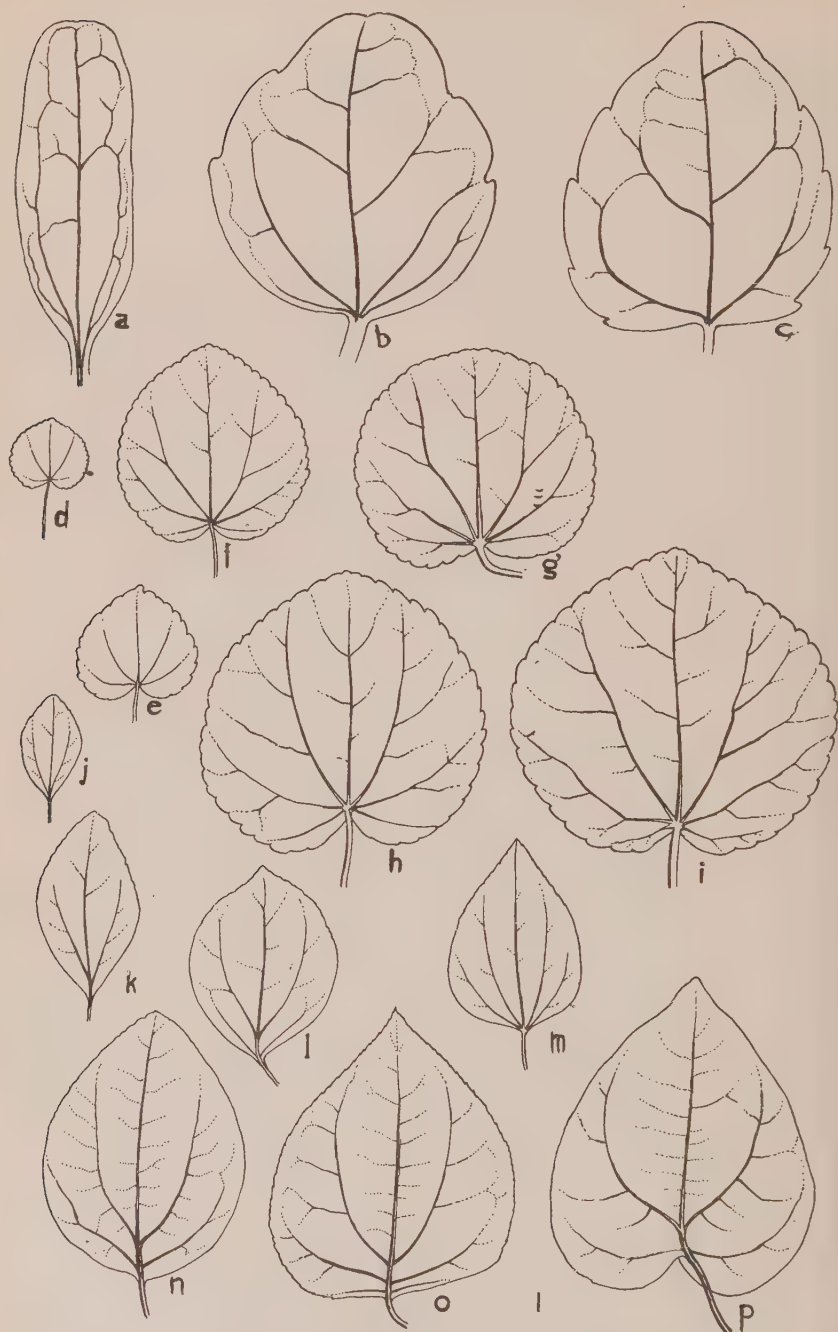


FIG. 1. a-c. Cotyledon and seedling leaves, *a*, $\times 7$, *b*, $\times 6$, *c*, $\times 5$. *d-i*. Outline tracings of the leaves of the short shoot, $\times \frac{1}{2}$. *j-p*. Same, of long shoot, $\times \frac{1}{2}$. In each figure, only the prominent veins are shown.

ships with such diversified plants as the conifers, palms, Leguminosae, Nyssaceae, Tiliaceae, Proteaceae, etc.

In view of the obvious polymorphism of the leaves of the surviving species of *Cercidiphyllum*, and in order to avoid overloading the literature with a host of fossil species based upon minor variations of leaf morphology, Brown recognized four fossil species based upon norms of foliar form; (1) elliptic to broad-ovate-elliptic with rounded or cuneate base in *C. ellipticum* (Newberry) Brown of the Upper Cretaceous and Paleocene, (2) deltoid with tendency to elongate apex and incipient cordate base in *C. arcticum* (Heer) Brown from the Paleocene to the middle Eocene, (3) elongate broad-lanceolate with cordate base in *C. elongatum* Brown from the middle or late Eocene to the upper Oligocene or lower Miocene and (4) cordate, slightly elongate and asymmetric in *C. crenatum* (Unger) Brown from the Oligocene to the late Miocene.

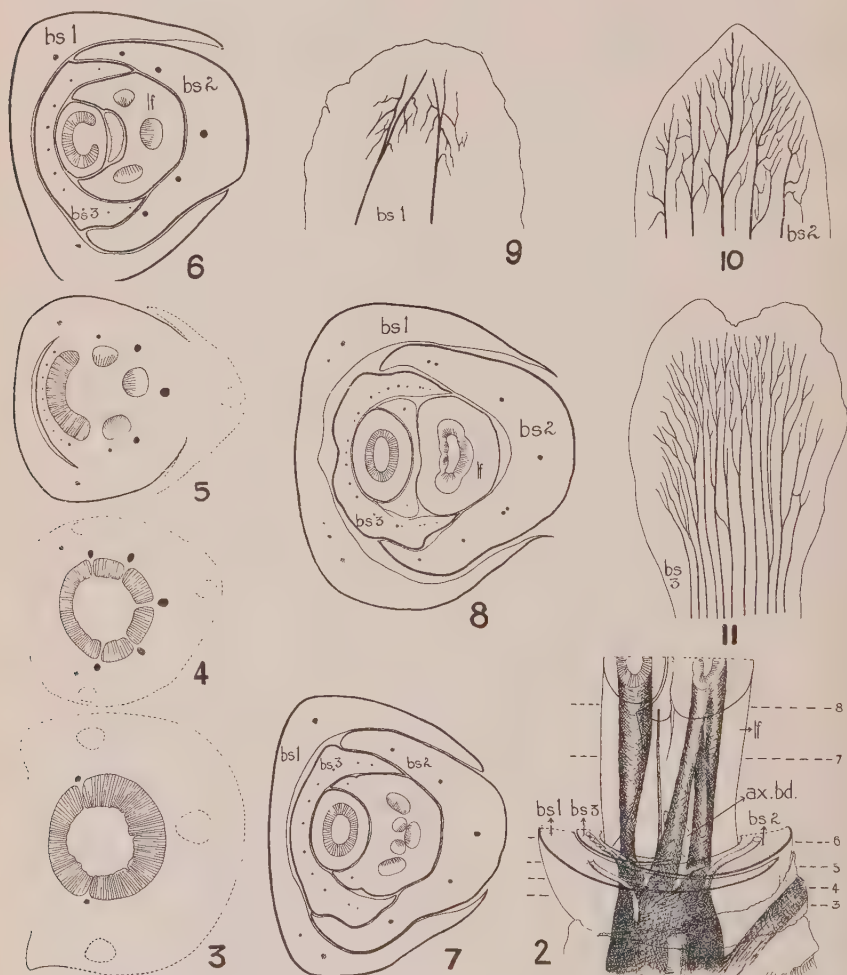
Although all five species of *Cercidiphyllum* exhibit wide ranges of foliar variability, it is evident that the frequency of occurrence of specific leaf forms changes in passing from the Upper Cretaceous *C. ellipticum* to the living *C. japonicum*. The broadly cordate leaves with crenate margins that Brown adopts as the norm of the latter species occur on the short shoots, whereas the leaves of the long shoots exhibit a much wider range of morphological variability which simulates that which occurs in the older fossil species. It appears likely that one of the extreme variant forms of the ancestral species may have stabilized on the short shoots of *C. japonicum* and possibly also of *C. crenatum*. This suggests that all of the leaves of *C. ellipticum* and *C. arcticum* may have been borne on long shoots. In any case, there are two norms of foliar form in *C. japonicum*, one characteristic of the short shoots and the other of the long shoots; the ratios of the two types of leaves fluctuating on a tree during successive parts of a growing season.

LEAF: VASCULATURE

Each of the cotyledons of *C. japonicum* is vascularized by two dichotomizing strands, the central branches of the dichotomies fusing to form the midvein of the cotyledon, *Fig. 1a*. The two strands are related to a single gap in the eustele of the cotyledonary node, *Fig. 55*. On the contrary, each of the paired primary leaves of the seedling is vascularized by three strands that are related to three separate gaps in the eustele, *Fig. 56*. The leaves of subsequently formed long shoots similarly are vascularized by three strands that are related to trilacunar nodes, *Fig. 57*. In contrast the leaves of the short shoots differ markedly in having three strands that are related to unilacunar nodes, *Figs. 5, 6*. The three strands behave similarly, however, in the petiole and lamina of leaves of both long and short shoots. In the basal part of the petiole two branches of the median strand pass* into an adaxial position with inverted orienta-

*The phraseologies used in this paper are descriptive of changes observed in successive serial sections and have no implications regarding ontogenetic or directional differentiation of the vascular elements.

tion of xylem and phloem, *Figs. 7 and 58*. These small strands with the three larger ones become aggregated into a vascular cylinder, *Figs. 8 and 59*, which extends throughout the central part of the petiole. Toward the base of the lamina, this vascular cylinder becomes invaginated on its adaxial side, *Fig. 60*, and gives rise to from five to seven U-shaped or concentric strands, *Figs. 61 and 62*, that constitute the primary veins of the palmate lamina.



FIGS. 2-11. *Fig. 2.* Diagrammatic reconstruction of the pattern of vasculature of a short shoot. *Figs. 3-8.* Transverse sections of the short shoot at levels as indicated by corresponding numbers in *Fig. 2*. *Figs. 9-11.* Drawings made from cleared preparations of the first, second and third bud scales to show the method of vascularization. (*bs1*—outermost bud scale; *bs2*—inner bud scale; *bs3*—innermost bud scale; *lf*—leaf; *ax. bd.*—axillary bud.)

LEAF: MISCELLANEOUS STRUCTURES

As observed and figured by Harms (13), there is a precocious development of concrescent stipules and large marginal glands even in leaf primordia that are still enclosed within the bud. As the leaf expands the adaxially oriented, conspicuously forked stipular appendage drops off and the glistening, hyaline glands abort, leaving more or less conspicuous depressions in the margin of the matured leaf. As noted by Solereder (31), the stomata are confined to the lower epidermis and are surrounded by from four to six ordinary epidermal cells. Rarely, however, one or two of the latter cells may undergo anticlinal division to form cells of smaller dimensions. The leaves do not contain secretory idioblasts or sclereids, nor do they form characteristic types of hairs or trichomes.

"FLOWER BUD" OF THE SHORT SHOOT

The bud of the sympodially elongating short shoot has three conspicuous reddish scales. The outermost of these (*bs1*) is connivent, viz. oriented with its dorsal side toward the main axis of the preceding year's growth, *Figs. 2, 6, and 8*. The second scale (*bs2*) is opposite the first and the third (*bs3*) in conformity with the first. A leaf (*lf*) with a bud (*ax bd*) in its axil forms opposite the innermost scale. The inflorescence is terminal. Thus, each year's elongation of the short shoot is produced by the activity of an axillary bud.

The outermost bud scale (*bs1*) contains two main veins that are related to two widely separated lacunae of the vascular cylinder, *Figs. 3-7*. These veins remain unbranched for some distance and then bifurcate, *Fig. 9*. Most of the branches arising from the veins tend to spread in a downward direction. The second bud scale (*bs2*) has five main veins that are associated with a corresponding number of lacunae, *Figs. 4-8*. The veins branch more or less profusely in the lamina and the branches anastomose forming a reticulate system, *Fig. 10*. The innermost bud scale (*bs3*) is supplied with from seven to eleven veins, arising from closely spaced but distinct lacunae, *Figs. 4-8*. The veins run parallel for a greater distance in the bud scale and then branch in a predominantly dichotomous manner, *Fig. 11*.

The parenchymatous tissue between the stelar bundles that alternate with those of the third bud scale soon become bridged by the activity of the cambium, and at a higher level the stele appears as a continuous arc on the adaxial side, *Fig. 5*. Conversely, on the side of the second bud scale, cambium fails to differentiate in the inter-fascicular regions excepting in the parenchyma flanking the median vein of the second bud scale. Thus, the vasculature on this side (right hand side in *Fig. 5*) becomes organized into three large strands. These enter the petiole, *Fig. 6*. It is evident, accordingly, that the three veins of the leaf of the short shoot are related to a single lacuna of the eustele in contrast to the nodal situation of the long shoot, where the three veins are related to three separate lacunae, *Figs. 56, 57*. The arc-shaped segment of the stele on the side of the third

bud scale soon becomes cylindrical, *Figs. 6, 7*, and continues into the reproductive axis.

THE FEMALE INFLORESCENCE

The reproductive axis is highly condensed and bears either carpels or stamens in conformity with the unisexuality of the plant. In the female inflorescence, the axis bears from two to six carpels, whose ventral sutures are characteristically directed away from the axis, *Figs. 12, 16*. At first sight the carpels seem to be aggregated in a cycle, but a careful examination reveals a more or less decussate arrangement, *Fig. 12*. Each carpel is subtended by a membranous bract. The relation of bracts to carpels is especially significant in those instances where more than four carpels are involved. As noted by Harms (13) and as is evident in *Fig. 20*, the bracts of the inner two "pairs" of carpels are distinct, originate at higher levels and do not represent parts of a single involucre.

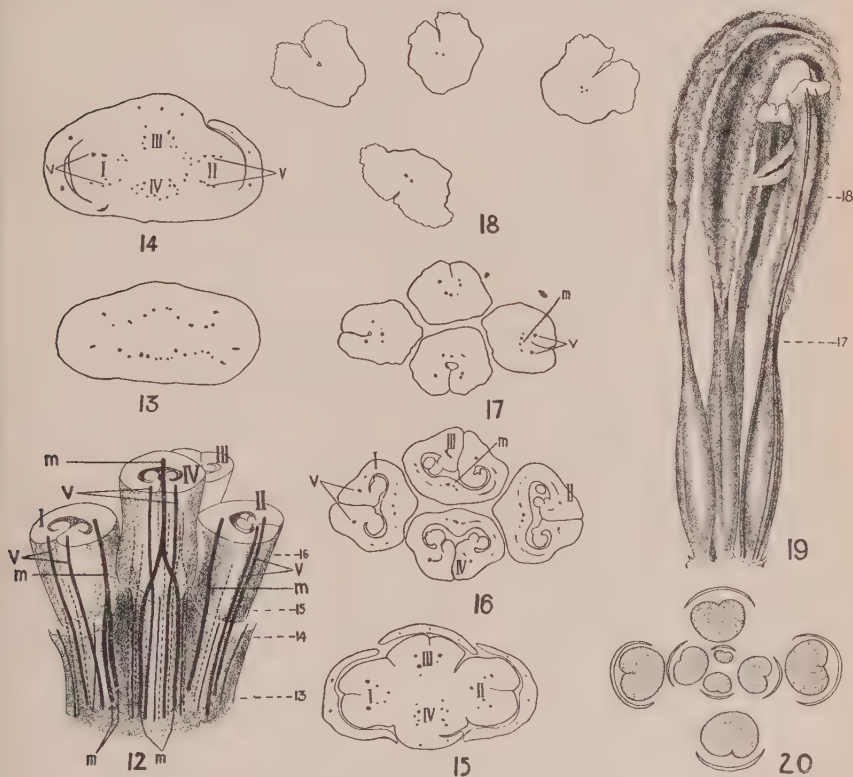
The shape, size and vascular supply of the bracts vary considerably. The bracts related to the outermost carpels generally are larger and more deeply lobed than those accompanying the inner carpels. The larger bracts usually receive three veins from the eustele of the reproductive axis, *Figs. 13, 14*; however, either the median or a lateral may be absent. The bracts subtending the inner carpels very rarely receive all three veins. Especially when the bracts are very much reduced, they may be unvascularized.

The carpel of *Cercidiphyllum* exhibits a particular trend of specialization of the primitive conduplicate megasporophyll* of the *Tasmania-Degeneria* type. It has acquired a much elongated form with a cylindrical ovule-bearing part and a long slender style having two extensively "decurrent" stigmatic ridges, *Fig. 19*. The external double stigmatic crests of the *Tasmania* type have been completely eliminated from the fertile part of the carpel, and the inner ventral surfaces beyond the placentae remain tightly adpressed, *Figs. 12, 16*, until dehiscence of the fruit. The stigmatic part of the carpel exhibits some flaring of the conduplicate surfaces, *Fig. 18*.

A reproductive axis bearing four carpels is illustrated in *Figs. 12-19*. After vascularization of the bracts, the bundles of the eustele resolve themselves into four groups, *Fig. 14 (i, ii, iii, iv)*. The peripherally situated bundles of each group (marked *v* in the figures) form the ventral veins of the corresponding carpels. The bundles that are situated towards the interior of the groups (marked *m* in the figures) give rise to the median vein. In the majority of cases, a single bundle from the stele departs into the carpel as its median vein, as in the carpel marked *ii* in the figures. Frequently, however, the median vein may be a fused product of two distinct stelar bundles, as in the carpels marked *i* and *iv* in the figures. Carpels exhibiting one or the other of these types of median veins fluctuate widely in distribution; some reproductive axes may have one type or both

*It seems wise to retain the terms megasporophyll and microsporophyll for descriptive purposes in dealing with the broader forms of angiospermic fertile appendages, without implications of their derivation from leaves.

types in varying proportions. A few of the remaining stelar bundles of each group disappear at the bases of the respective carpels, although some of these veins may occasionally traverse the tissue of the carpel for a short distance (such veins are indicated by broken lines in *Fig. 12*).



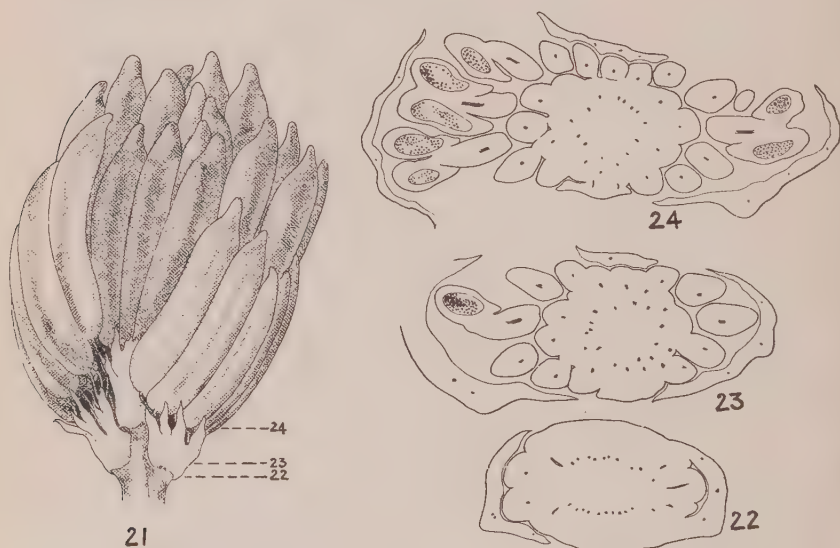
FIGS. 12-20. *Fig. 12*. Three-dimensional drawing of the vascular system of the female reproductive axis and carpels (vasculature of carpel marked III is not shown). *Figs. 13-18*. Transverse sections of the female reproductive axis and carpels as indicated by corresponding numbers in *Figs. 12* and *19*. *Fig. 19*. Four carpels from a reproductive axis, showing the general form. Vasculature is shown only for the carpel on the right-hand side. *Fig. 20*. An optical transverse section of a female reproductive axis bearing eight carpels, showing the relationship of the carpels and bracts. (*m*—median vein of the carpel; *v*—ventral vein).

It may be noted that generally a larger number of stelar bundles are aggregated below the ultimate carpel (number *iv* in the case illustrated in *Figs. 12, 14*). In addition to forming the median and ventral veins of the carpel, many of these bundles continue into the base of the carpellary wall (veins indicated by broken lines in carpel *iv*, *Fig. 12*). Within the carpel, the median vein gives off lateral branches that spread in the ovary

wall. The ventral veins, after vascularizing the ovules, extend upward in the style for more than half its length, *Fig. 17*; (also, carpel on the right hand side in *Fig. 19*).

THE MALE INFLORESCENCE

The male reproductive axis terminates in a cluster of stamens, subtended not infrequently by four membranous bracts corresponding to those associated with the carpels. It is important to note that the bracts tend to be arranged in opposite pairs on the reproductive axis, at slightly different levels and not in a truly cyclic manner, *Figs. 21, 22*. Furthermore, each bract appears to subtend an individual aggregation of stamens, the number of stamens in each aggregate varying from 8 to 13. The relation of the bract to the aggregation of stamens is particularly evident in the lower part of the axis, *Fig. 21*.



FIGS. 21-24. *Fig. 21*. Male reproductive axis. Note the arrangement of stamens in bunches, each bunch being related to a bract. *Figs. 22-24*. Transverse sections of the same from levels as marked by corresponding numbers in *Fig. 21*.

Although each bract in general is supplied with three vascular strands from the stele of the reproductive axis, the range of variation cited in connection with the bracts of the female reproductive axis is often encountered here also. After the vascularization of the bracts, the remaining bundles of the stele soon become centrifugally distributed, and each bundle supplies a single stamen, *Figs. 22-24*.

In the young condition, before the opening of the bud scales, the stamens have relatively long anthers and very short "filaments," *Fig. 21*. On the

contrary, at anthesis the "filaments" become greatly elongated and are nearly as long or even longer than the anthers. The "connective" is much reduced and the elongated sporangia are oriented in a latrose position. However, the microsporophyll broadens beyond the sporangial region forming a short conical apex. The staminal vascular bundle runs unbranched almost to the distal extremity of the stamen.

NATURE OF THE "FLOWERS"

As emphasized by Solereder (31) and subsequently by Harms (13), the abaxial orientation of the ventral sutures of the carpels in *Cercidiphyllum japonicum* is a serious, if not an insuperable, obstacle to interpreting the female reproductive structures as a single flower. A detailed study of successive stages in the development of carpels and fruits reveals no evidence of "twisting," Hutchinson (18), or resupination. Furthermore, the vascularization pattern of the reproductive parts negates any assumption of torsion or rotation. As previously indicated the ventral veins of the carpel are derived from bundles situated toward the periphery of the axis whereas the dorsal vein arises from a more centrally situated bundle or bundles, *Figs. 14, 15*. The decussate arrangement of paired carpels with their subtending bracts — particularly where six carpels are present — invalidates any interpretation of the bracts as parts of a single involucre, as noted by Harms (13).

That the reproductive structures of *Cercidiphyllum japonicum* were actually derived by extreme reduction of an inflorescence is clearly demonstrated by paleobotanical evidence, Brown (5). In *Cercidiphyllum ellipticum*, *C. arcticum* and *C. elongatum* the fruits were borne on a much elongated axis and in the case of the first species on a branching inflorescence. Indeed, Brown concludes that "The fruits, at least in the early species, were borne in racemes, the individuals being indiscriminately alternate and opposite in the same raceme." Thus, each carpel of *C. japonicum* represents the vestige of a much reduced female flower and by homology each of the smaller aggregates of stamens with its subtending bract is the remains of a single male flower.

Two different trends in the reduction of the female flower to a single carpel with a subtending bract have been suggested by Solereder (31) and Harms (13). The two possibilities are graphically illustrated in *Fig. 25*. According to Solereder, the ancestral female flower of *Cercidiphyllum* might have possessed at least two carpels whose ventral sutures faced one another, *Fig. 25,A*. In each flower, the particular carpel which has its ventral suture adaxially oriented disappeared during subsequent evolution, *Fig. 25,B*, and the carpel which has its ventral suture abaxially oriented survived, *Fig. 25,C*.

On the contrary, Harms emphasized the similarity between the orientation of the carpel on the axis of the reduced inflorescence and that of the first bud scale on the vegetative axis. He hypothesized that the bud scale became fertile and transformed into a carpel and that the vegetative leaf

or its stipular appendage became the subtending bract of the carpel, *Fig. 25, D-F*.

Both of these suggestions are obviously highly speculative, but Solereder's concept is preferable owing to its directness and simplicity, involving merely loss of parts and not calling upon complex transformations of bud scales into carpels and of leaves into bracts. Unfortunately there are no reliable data available for thoroughly substantiating what actually occurred. Although the supernumerary bundles at the base of the carpels are indica-

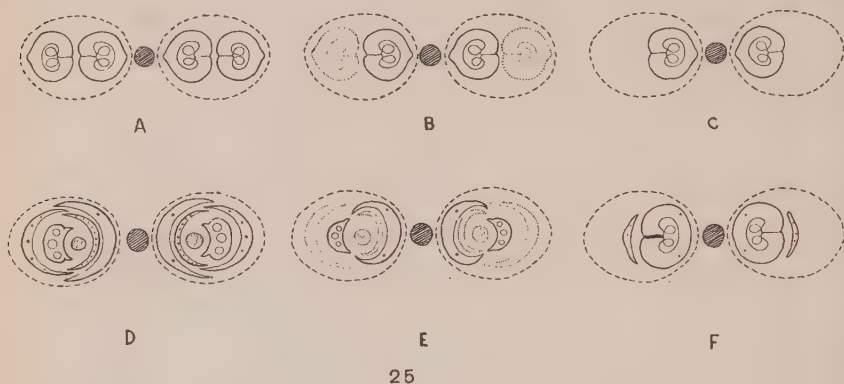


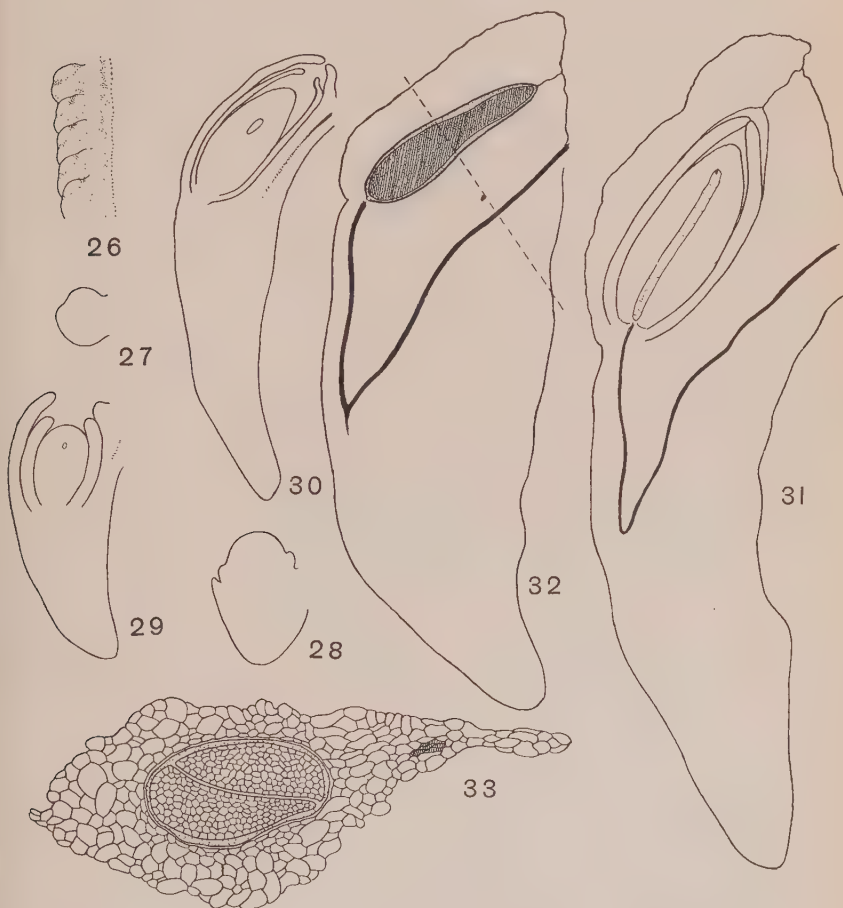
FIG. 25. Schematic representation of the two interpretations of the "flower" of *Cercidiphyllum*. A-C conveys Solereder's view and D-F, that of Harms.

tive of a loss of parts, reduction has progressed to a stage where it is impossible to determine with certainty the number and character of the appendages that may have been eliminated. Through the courtesy of Dr. Roland W. Brown, we have been able to examine the inflorescences of fossil species. Some of these bear paired carpels (fruits), but the preservation of the material is such (compressions and casts) that there is no conclusive evidence to indicate whether the ventral sutures of the paired carpels face one another or are oriented as in the much compressed inflorescence of *C. japonicum*. The discovery of favorably preserved material may clarify the issue.

EMBRYOLOGY

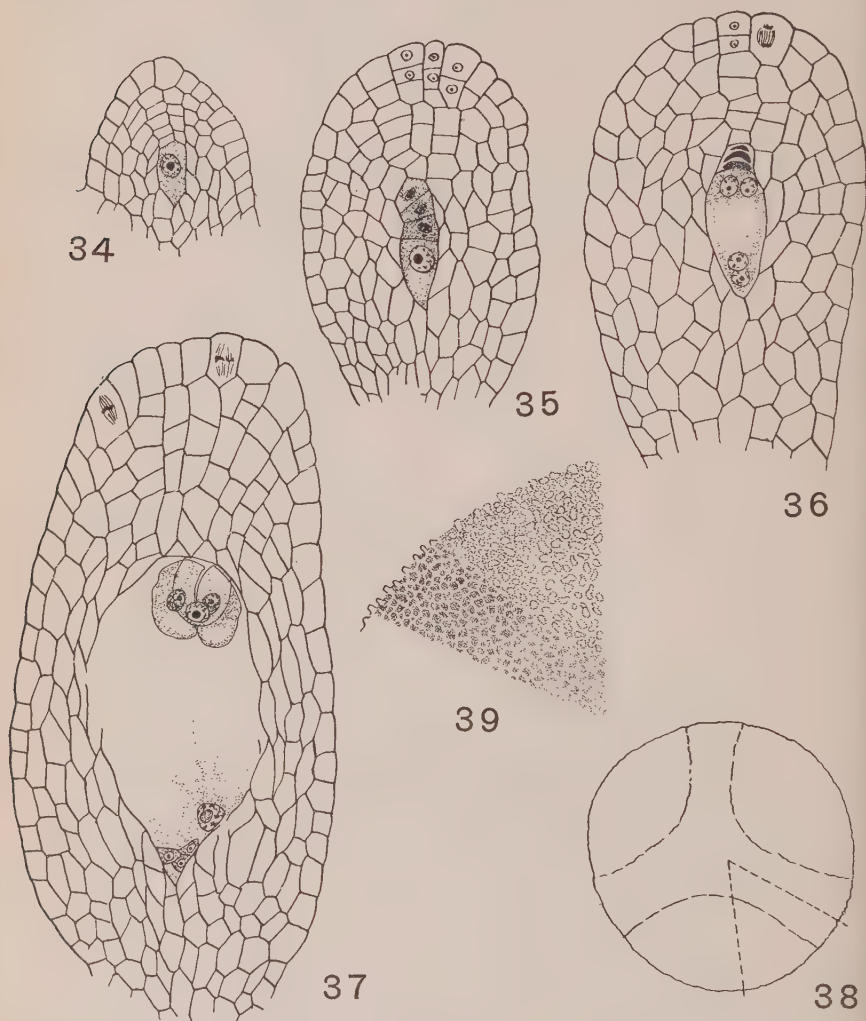
A single row of ovular primordia originates on each placenta. At first, the ovules appear as tiny knobs, *Fig. 26*, and even before the differentiation of the integuments, assume an orientation more or less parallel to the placenta, *Fig. 27*. During the development of the integuments, *Fig. 28*, the chalazal end of the ovule grows at a very rapid rate in the form of a flattened tapering projection, *Figs. 29-32*, which later develops into a wing. The differentiation of the vascular bundle in the ovule is rather late. The procambium of the bundle appears first in the funicular region, when the embryo sac is already in the 2- to 4-nucleate stage, *Fig. 29*. Even at the

time of fertilization, the procambium does not extend as far as the nucellus, nor have many of the constituent cells of the bundle become differentiated as spiral elements, *Fig. 30*. It is only after fertilization that the bundle undergoes a rapid and complete development. It first proceeds in the direction of the chalaza, and in the middle of the wing takes a circuitous course to reach the base of the nucellus, *Figs. 31, 32*.



FIGS. 26-33. *Fig. 26*. Ovular primordia on a placenta as seen in dissected preparations, $\times 70$. *Fig. 27*. Longitudinal section of an ovular primordium at a slightly later stage than in the previous figure, $\times 35$. *Fig. 28*. Same, at the time of the origin of integuments, $\times 35$. *Fig. 29*. Longitudinal section of an ovule when the megaspore mother cell is differentiating in the nucellus, $\times 35$. *Fig. 30*. Same, at the time of fertilization, $\times 35$. *Fig. 31*. Same, at an early stage in the formation of the endosperm, $\times 35$. *Fig. 32*. Longitudinal section of a mature seed, $\times 20$. *Fig. 33*. A section of the seed passing along the broken line in *Fig. 32*, $\times 70$.

The two integuments arise more or less simultaneously, *Fig. 28*. The outer integument grows beyond the inner, *Fig. 29*, and both the integuments take part in the construction of the micropyle, *Fig. 30*. The inner integument is from two to three layers of cells in thickness and the outer from four to five layers of cells at the time of anthesis. During subse-



FIGS. 34-39. *Fig. 34*. Longitudinal section of the nucellus showing the megaspore mother cell, $\times 240$. *Fig. 35*. Same, showing linear tetrad of megaspores, $\times 240$. *Fig. 36*. Same, showing 4-nucleate embryo sac, $\times 240$. *Fig. 37*. Same, showing mature embryo sac, $\times 240$. *Fig. 38*. Outline drawing of the polar view of a pollen grain, $\times 1500$. *Fig. 39*. Portion of the pollen grain, enclosed within the broken lines in *Fig. 38*, enlarged to show the sculpturing, $\times 3000$.

quent development, the inner integument becomes crushed and the outer one undergoes certain modifications which will be described in connection with the seed.

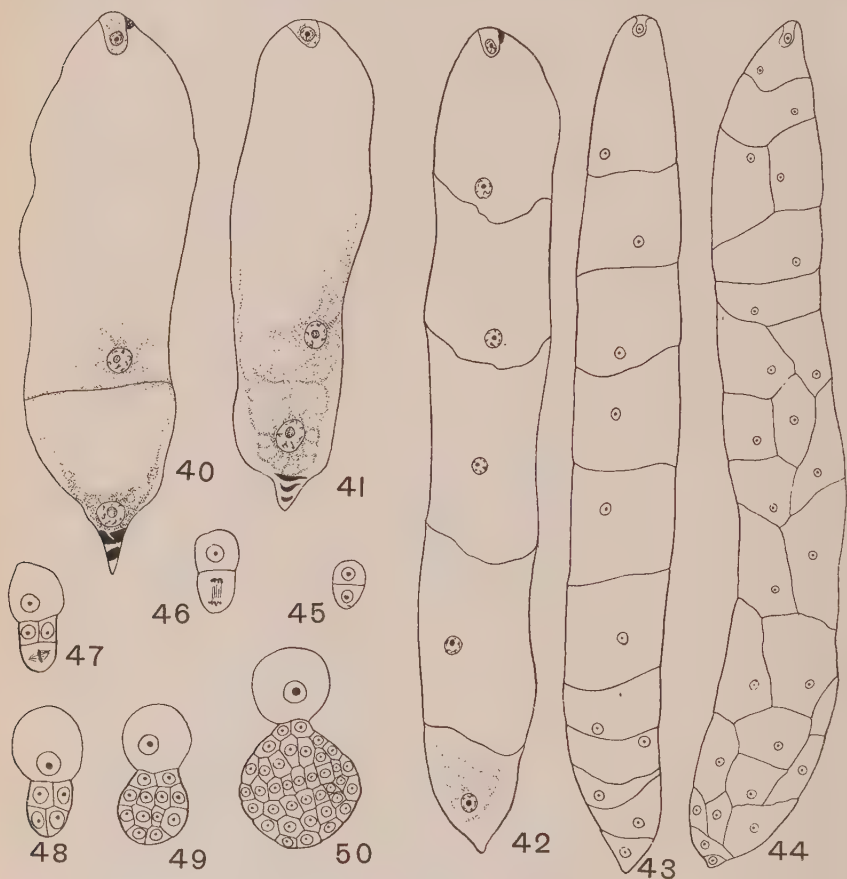
The primary archesporial cell differentiates in the hypodermal layer of the nucellus and divides by a periclinal wall into primary parietal and sporogenous cells. The former cell further divides in the same plane to give rise to from four to five parietal cells, *Fig. 34*. The epidermal cells capping the parietal tissue also undergo periclinal divisions to produce two or three additional layers that merge with the nucellus, *Figs. 35–37*. The sporogenous cell functions as the megaspore mother cell, *Fig. 34*. It divides meiotically to produce a linear tetrad of megaspores, *Fig. 35*, the chalazal megaspore further developing into the 8-nucleate embryo sac, *Figs. 36–37*. The antipodal nuclei organize into cells and the polar nuclei fuse before fertilization, *Fig. 37*.

The structure of the anther and the development of the male gametophyte do not deviate from the usual method known for the majority of dicotyledons. The anther tapetum is of the binucleate and secretory type. Microspore tetrads are formed by a simultaneous method of reduction divisions. After the formation of the vegetative and generative cells, the microspores are ready to be shed, and the division leading to the formation of the gametes takes place in the pollen tube.

The spherical and tricolpate pollen grains of *Cercidiphyllum* are very distinctive. The furrows are so broad that they occupy more than half the surface of the grain, *Fig. 38*. It frequently is difficult to determine where the furrows begin and where the exine ends. The exine is finely pitted. The floor of the furrow is flecked with minute granulations, *Fig. 39*.

After fertilization, the embryo sac expands in a direction parallel to the long axis of the ovule. The primary endosperm nucleus moves towards the chalazal end of the sac and divides; the division being followed by the deposition of a wall. As a result, the embryo sac becomes transversely partitioned into a larger micropylar chamber and a smaller chalazal cell, *Fig. 40*. The latter often shows a denser accumulation of cytoplasm with characteristic vacuolation, *Fig. 41*. However, by the time the upper chamber divides into four to six cells, *Fig. 42*, the cytoplasm of the chalazal cell thins down and the cell begins to divide. The early divisions in both the cells of the 2-celled endosperm, *Figs. 40, 41*, take place essentially by transverse walls until from two to twelve endosperm cells are formed, *Fig. 43*. Simultaneously with these divisions, the embryo sac undergoes considerable longitudinal stretching and presents a very much elongated structure as shown in *Figs. 42–44*; so that the antipodal end of the embryo sac comes in contact with the vascular bundle of the ovule, *Fig. 31*. Subsequent divisions in the endosperm cells take place in various oblique planes, *Fig. 44*, and finally produce a compact mass of nutritive tissue, a large proportion of which, however, is used up by the embryo.

The zygote divides only after the endosperm cells begin dividing in oblique planes, as represented in *Fig. 44*. The basal cell of the 2-celled proembryo, *Fig. 45*, does not divide further but undergoes conspicuous enlargement, *Figs. 47-50*. The terminal cell divides by a wall parallel to the first, *Fig. 46*, so that the proembryo now consists of a linear row of three cells. The next division in the two derivatives of the terminal cell



FIGS. 40-50. *Figs. 40-44.* Stages in the development of the endosperm, $\times 140$. *Figs. 45-50.* Stages in the development of the embryo, $\times 560$.

takes place by vertical walls, *Figs. 47, 48*. Subsequent divisions in these cells result in the quadrant and octant stages, which by further development give rise to the mature embryo. At the stage of dispersal of the seed, the embryo is well differentiated and possesses a long hypocotyl and two cotyledons that enclose the primary shoot apex. A few layers of endosperm cells may persist as remnants around the embryo, but are insignificant, *Figs. 32, 33*.

In the mature seed, the outer integument becomes slightly compressed in the plane of the flattened wing; therefore, the chalazal wing appears to be extended on either side of the seed, *Fig. 33*. In the chalazal region of the wing, the cells are unequally and variously enlarged so as to present a more or less spongy texture. The vascular bundle retains its downwardly projecting loop, *Fig. 32*.

SECONDARY XYLEM AND PHLOEM

The secondary xylem of *C. japonicum* has been described by a succession of investigators. Therefore, certain features only need be commented upon by us. The growth rings as seen in transverse sections of the wood, *Fig. 51*, are delimited by three to five layers of radially compressed imperforate tracheary elements. The thin-walled, angular vessels are diffusely scattered, but in some specimens those of the early-wood are conspicuously larger than those of the late-wood, *Fig. 51*. The vessel members are very long with extensively overlapping ends, indicative of their formation by a relatively primitive form of non-storied cambium. The "perforation plates" are scalariform with numerous slender bars, *Fig. 54*. The vessel members frequently extend beyond the perforated facets in the form of narrow tapered ends, having "tertiary" helical thickenings, *Fig. 54*. The intervacular pitting fluctuates between scalariform, transitional and opposite. The rays of the first-formed secondary xylem are closely spaced, longitudinally extensive and mostly uniseriate, but in passing outward radially soon develop biseriate parts, *Fig. 52*. The rays of the later formed wood are lower, more widely spaced and typically heterogeneous, *Fig. 53*. The ray-vessel pitting varies from scalariform to transitional to opposite. Relatively large crystals of calcium oxalate occur more or less sporadically in the erect cells of the heterogeneous rays. Xylem parenchyma is apotracheal, scanty, diffuse, and terminal. The imperforate tracheary cells have conspicuously bordered pits in both their radial and their tangential walls. Although the cambium, vessels and imperforate tracheary cells are of relatively primitive dicotyledonous types, the ray structure is of a form indicative of an advanced stage in the ontogenetic and phylogenetic reduction in width and height of the multiseriate rays, Barghoorn (2).

According to Solereder (31), the bark contains isolated strands of sclerenchyma. In old stems, however, the sclerenchyma of the secondary phloem occurs in the form of successive concentric bands of varying circumferential extension.

Among plant fossils from early Tertiary beds of East Greenland, is a fossil wood from Cape Dalton which was assigned to *Corylopsites groenlandicus* by Mathiesen (21). This wood closely resembles that of *Cercidiphyllum* and of certain species of *Corylopsis*. It bears evidences of crystals in its wood parenchyma and rays, and was referred to *Corylopsis* by Mathiesen owing to the absence of such crystals in wood of *Cercidiphyllum* examined by him. The abundance of leaves of *Cercidiphyllum*

in early Tertiary strata of northern lands suggests, as noted by Brown (5), that *Corylopsites groenlandicus* is in all probability the wood of *Cercidiphyllum*.

AFFINITIES OF CERCIDIPHYLLUM

Although the genus *Cercidiphyllum* was established by Siebold and Zuccarini in 1846, the plant *C. japonicum* remained without a specific name until Hoffman and Schultes (17) formalized its binomial, but no attempt was made to determine its affinities. In his remarks on the Hamamelidaceae, Baillon (1) casually raised the question whether *Cercidiphyllum* should be included under that family, noting foliar similarities with *Disanthus*. However, he also called attention to analogies with *Spiraeanthemum* of the Cunoniaceae (Saxifragaceae), viz. opposite leaves, hypogynous and apocarpous ovary and winged seeds. Maximowicz (22) associated *Cercidiphyllum* with *Trochodendron*, and particularly with *Euptelea*, in the Magnoliaceae, stressing the occurrence of stipules as evidence of relationship to that family.

Subsequent authors generally follow the lead of either Baillon or Maximowicz. Thus, Solereder (31), Hallier (8, 9, 10, 11), Lotsy (20), McLaughlin (23) and Croizat (6) emphasize similarities to the Hamamelidaceae, whereas Prantl (26), Harms (12, 13, 14), Bessey (4), Hayata (16), Hutchinson (18), Diels (7), Lemesle (19) and others favor retaining *Cercidiphyllum* within the Ranales (or Magnoliales) either as a member of the Magnoliaceae or the Trochodendraceae or as the representative of a monotypic family, the Cercidiphyllaceae.

The first comprehensive comparative studies of *Trochodendron*, *Tetracentron*, *Euptelea*, *Cercidiphyllum* and *Eucommia* (both of their external morphological characters and their internal structures) are those of Harms (12) and van Tieghem (33). Although cognizant of outstanding differences between the five genera, Harms, owing to an evident prejudice against small families, placed *Tetracentron* in the Magnoliaceae and the remaining four genera in the Trochodendraceae. On the contrary, van Tieghem, utilizing similar comparative evidence, placed each of the five genera in an independent family, grouping the monotypic Trochodendraceae and Tetracentraceae with the vesselless Winteraceae in a new order, the Homoxylées. It should be noted in this connection that Harms (13) later recognized the necessity of removing *Tetracentron* from the Magnoliaceae, of placing *Cercidiphyllum* in a family of its own within the Ranales and (15) of transferring the monotypic Eucommiaceae to the Urticales where Tippon's (34) subsequent investigations indicate that it in all probability belongs. Harms' (13) comments upon the taxonomist's difficulties in dealing with such genera as *Cercidiphyllum*, *Trochodendron* and *Tetracentron* are particularly significant. He states regarding *Cercidiphyllum*:

"On the whole the genus gives us many a problem; its morphological structure shows so many peculiarities that it is hard to find the correct place in the

system for the genus. But so it is with many other genera from eastern Asia. Often one does not know where to place these odd forms or to what more widely distributed and more richly developed families one should connect them. We may as well assume that these are old genera whose closer relations no longer exist. They are remainders of some more richly developed forms from former geological periods, now unknown to us, projecting into today's flora, in which they appear strange. Both the Japanese genus *Trochodendron* and *Tetracentron*, a genus growing with *Cercidiphyllum* in the mountains of central China and placed in the Magnoliaceae, where it does not belong, are isolated types."

This tendency among taxonomists and morphologists for gradually recognizing the necessity of segregating such relic genera in independent families of their own is in marked contrast to the highly speculative deductions of Hallier (11), who included *Trochodendron*, *Tetracentron*, *Euptelea*, *Cercidiphyllum* and *Eucommia* in the Hamamelidaceae along with the Balanopsidales, Batidales, Buxaceae, Geissolomataceae, *Daphniphyllum*, *Myrothamnus*, *Platanus* and other plants of doubtful affinities. Such a procedure stretches the family beyond the elastic limits of even a natural order.

Much of the confusion during the last fifty years in discussions of the angiosperms is due to the interjection of phylogenetic concepts into systems of classification that were not developed originally from an evolutionary point of view. The older systems are logical arrangements designed to facilitate accurate identification and to provide efficiency in the codification and use of specimens in large herbaria. The groupings of plants were primarily based upon morphological similarities in one or another of their parts. Modern attempts to arrange the larger groupings, viz. families and orders, in phylogenetic series, deriving one grouping directly from another, lead inevitably to increasing confusion and controversy. This is due to the fact that, in dealing with the survivors of very ancient angiospermic floras, such phylogenetic arrangements, based upon the study of specific selected parts of the plants, commonly are invalidated by evidence from other organs or parts of the same plants. The most that may be inferred from the *totality* of evidence from all organs and parts of the plants is, in a majority of cases, the conclusion that the related groups of plants were derived from common ancestors, now extinct. Furthermore, although *negations* of putative phylogenetic derivations are simple and conclusive, *positive* assertions regarding evolutionary derivations are difficult and uncertain owing to the common occurrence of parallel and convergent trends of morphological and anatomical specializations in all organs of the vascular plants. That similar end-products, resulting from such evolutionary trends, are of widespread and frequent occurrence among animals is becoming increasingly recognized by zoologists in dealing with both vertebrates and invertebrates.

Before attempting to arrange surviving angiosperms in phylogenetic series, it is essential to obtain reliable evidence regarding salient trends of evolutionary specialization in the various organs and internal structures of

these plants. Such evidence can be acquired only by comprehensive and time-consuming investigations of the dicotyledons and monocotyledons *as a whole*. In the case of the vascular tissues, accumulated data indicate that an adequate record of the derivation of vessels from modified tracheids and of the varied trends of specialization of vessel-containing xylem is preserved among both living dicotyledons and monocotyledons. However, it is evident from this record that similar or parallel trends of structural specialization have occurred repeatedly and independently in remotely related dicotyledonous families.

The voluminous data accumulated by successive generations of taxonomists provide abundant material for the study of varied trends of cohesion and adnation of floral parts and of simplification and reduction of inflorescences and flowers. Furthermore, the study of new and neglected plants from northern Australia, New Guinea, New Caledonia, Fiji and adjacent regions is yielding significant clues regarding the primitive form of the angiospermic carpel and stamen. Here again, as also in the case of angiospermic pollen, it is becoming increasingly evident that similar end products of specialization frequently develop independently through parallel or convergent evolution. Although much less is known at present regarding reliable trends of phylogenetic specialization in leaves and seeds of dicotyledons, sufficient evidence is available to indicate that morphological and structural similarities, *by themselves*, are not indicative necessarily of close genetic relationship between plants in which they occur.

Although specific parts of *Cercidiphyllum* exhibit similarities to homologous parts of other plants, the totality of evidence from all parts of the plants is not indicative of close relationship of *Cercidiphyllum* to any particular family of the dicotyledons. Many of the similarities stressed by those desirous of including *Cercidiphyllum* in the Magnoliaceae, Trochodendraceae or Hamamelidaceae are superficial and lose their significance when closely analyzed. Stipules, palmate venation, marginal glands and trilacunar nodal attachments of leaves occur in diverse families of dicotyledons, yet the presence of stipules is utilized by some as evidence of relationship to the Magnoliaceae and by others to the Hamamelidaceae. Similarly, stipules and palmate venation are stressed by some as indicative of affinity to *Tetracentron* and by others to certain selected genera of the Hamamelidaceae. It should be emphasized in this connection, however, that more detailed studies of the leaves reveal significant differences in the vasculature of the petioles and in the stomata of *Cercidiphyllum*. In addition, the leaves of this genus do not form types of idioblasts and other cellular structures that occur characteristically in the Magnoliaceae, *Tetracentron*, *Trochodendron* and various genera of the Hamamelidaceae.

Excessive emphasis has been placed in the past upon superficial resemblances due to analogous stages in the reduction of the perianth and other floral structures. In *Trochodendron* and *Tetracentron*, where the totality of evidence is clearly indicative of relatively close relationship between the two genera, the unsealed conduplicate carpels exhibit incipient lateral cohe-

sion, conspicuous nectariferous dorsal bulges and pronounced abaxial deformation either preceding or following anthesis. In contrast, the free, style-less carpels of *Euptelea* have elongated stipes and the stigmatic margins of the conduplicate megasporophyll are restricted by concrescence to a localized, more or less concave part of the ventral side of the carpel. In the Hamamelidaceae, as in many of the Cunoniaceae and Saxifragaceae, there is a marked tendency for the carpels to be reduced to pairs which have more or less extensive cohesion of their ventral surfaces. Thus, there are distinct and entirely different trends of specialization in the carpels of *Tetracentron* and *Trochodendron*, of *Euptelea*, and of the Hamamelidaceae, no evidence of which are detectable in the solitary carpel of *Cercidiphyllum*.

The pollen grains of *Tetracentron*, *Trochodendron* and certain of the Hamamelidaceae, as of many other dicotyledons, are tricolpate. Those of *Cercidiphyllum* are tricolpate, but differ markedly in the unusual breadth of their poorly defined furrows and in the detailed structure of their exine.

Embryological investigations have revealed no cogent evidence for including *Cercidiphyllum* in the Hamamelidaceae. The epidermal cells of the nucellus in *Cercidiphyllum* undergo a few periclinal divisions which result in an increased number of parietal layers, a phenomenon that has not been recorded in the Hamamelidaceae (27, 35). Following fertilization, the embryo sac of *Cercidiphyllum* undergoes a conspicuous elongation lengthwise, a feature which is unknown in the ovules of the Hamamelidaceae. The development of endosperm in *Hamamelis* (27), *Fothergilla* (35), and *Corylopsis* is strictly nuclear, whereas in *Cercidiphyllum* it is cellular.

The seeds of the Hamamelidaceae are of two different structural types: (1) those having a highly opaque, hard testa without wings, and (2) those that form a less opaque, relatively soft coat, whose margins become flattened to form a wing-like expansion. Seeds of the latter category are of less frequent occurrence in the family, being confined to the genera *Bucklandia*, *Liquidambar* and *Altingia*. The seeds of *Cercidiphyllum* are winged, but those who favor hamamelidaceous affinities for *Cercidiphyllum* have been too sanguine in citing this character as evidence in support of their contention. Winged seeds are of common occurrence and the presence of a wing in itself is not indicative necessarily of close relationship.

In the seeds of *Liquidambar* and *Altingia*, the outer integument surrounding the micropyle has undergone excessive flattening and considerable extension longitudinally to form the wing. The wing is radially symmetrical and its cells are uniform and more or less homogeneous. In *Bucklandia*, the histologically similar wing develops asymmetrically and diagonally from the outer integument on the side of the ovule opposite the raphe. There is no conspicuous extension of the chalazal end of the ovule or seed in these hamamelidaceous genera and the course of the raphe bundle is normal. On the contrary, the ovules of *Cercidiphyllum*

initiate the development of a subchalazal projection at an early stage of their ontogeny, viz. megaspore mother cell stage. Subsequent longitudinal and unilateral expansion of this subchalazal outgrowth forms the conspicuous wing of the mature seed. The raphe bundle forms a circuitous loop in the wing before reaching the chalaza, comparable to the hair-pin bend of the vascular bundle in the subchalazal prolongations of the ovules and seeds of *Trochodendron* and *Tetracentron*, Nast and Bailey (24).

The seeds of the latter genera, however, differ from those of *Cercidiphyllum* in having slender subchalazal elongations without broad wing-like modifications, in forming sclerenchymatous layers of characteristically elongated cells, and in containing a rudimentary embryo embedded in abundant endosperm. In addition, the epidermis of the outer integument consists of longitudinally elongated cells which impart a striated appearance to the seeds, whereas in *Cercidiphyllum* the homologous tissue is composed of cells which by enlargement produce a spongy texture.

The haploid number of chromosomes is commonly 12 in Hamamelidaceae. According to Whitaker (36), the haploid number is 14 in *Euptelea*, *Illicium* and the Schisandraceae, and 19 in *Cercidiphyllum*, *Trochodendron*, *Tetracentron*, the Winteraceae and the Magnoliaceae (*sensu stricto*). However, the occurrence of 14 haploid chromosomes in one investigated species of *Michelia* (32) suggests that many additional representatives of the Winteraceae, Magnoliaceae, Schisandraceae, and Illiciaceae should be studied before relying upon chromosome numbers in discussions of relationships within the Ranales.

The wood of *Cercidiphyllum* closely resembles that of certain representatives of the Hamamelidaceae, e.g. *Corylopsis*. However, this similarity, *by itself*, is not indicative necessarily of close relationship, since similar combinations of anatomical characters occur in other families which have retained relatively primitive cambia, vessels and imperforate tracheary cells while undergoing analogous reductions in the width and height of their multiseriate rays. In fact, the similarities in the case of *Corylopsis* and *Cercidiphyllum* are no more remarkable than are those between the woods of such remotely related plants as *Maclura pomifera* (Raf.) Schneid. of the Moraceae and *Robinia pseudoacacia* L. of the Leguminosae.

Thus, a summation of evidence from all organs and parts of *Cercidiphyllum* provides no cogent arguments for including this genus in any particular family of the dicotyledons. Therefore, we agree with van Tieghem (33) and subsequent writers who place the genus in an independent family of its own, the Cercidiphyllaceae.

Having established an increasing number of new independent families, taxonomists are faced with the problem of incorporating them in some logical and useful major system of classification. The role of the morphologist, anatomist, paleobotanist or cytogeneticist should be to provide significant and helpful data rather than to attempt to dictate solutions of this difficult problem upon their own terms. As previously stated, premature efforts to arrange living angiosperms in putative phylogenetic series,

deriving one family or order directly from another (Hallier and others) will lead only to increasing confusion and controversy. The study of major trends of phylogenetic modification of specific organs or parts of the dicotyledons and monocotyledons is yielding much significant information, but it should be recognized that no single one of these phylogenies can be utilized by itself in arranging plants in a similar linear series, since such a procedure is usually negated by evolutionary trends in other parts of the plants.

The Ranales, as broadly conceived by Engler and Prantl, obviously associates plants of widely varying degrees of relationship and of morphological and anatomical specialization. Two different categories of families may be recognized to advantage within the order: (1) the Winteraceae, Degeneriaceae, Magnoliaceae (*sensu stricto*), Himantandraceae, Eupomatiaceae, Annonaceae, Myristicaceae, *Canellaceae, Calycanthaceae, Austrobaileyaceae, Monimiaceae, Gomortegaceae, Lauraceae, Hernandiaceae and Lactoridaceae, having characteristic secretory cells ("ethereal oil cells") and monocolpate pollen (or phylogenetically modified types of such pollen), and (2) the Ranunculaceae, Berberidaceae, Lardizabalaceae and Menispermaceae, having tricolpate pollen (or types derived from such pollen) and no "ethereal oil cells." Monocolpate pollen occurs in many seed ferns, Bennettitales, Cycadales, Ginkgoales and monocotyledons, whereas tricolpate pollen and its modifications characterizes most dicotyledons.

The plants of the first ranalian category are predominantly woody (normal trees and shrubs), having simple pinnately veined leaves (except the Hernandiaceae), syndetocheilic-appearing stomata, and seeds with copious endosperm and rudimentary embryos. They retain many early trends in the differentiation of sepals and petals and in the specialization of primitive conduplicate, unsealed carpels, broad microsporophylls and staminodes, as well as of vessels and other vascular structures. The second category of ranalian plants exhibits conspicuous trends toward the acquisition of herbaceous or scandent habits, have a high ratio of palmate venation, and form haplocheilic stomata. Although predominantly apocarpous, their flowers have in general attained advanced stages of modification, and their vascular tissues are highly specialized. However, they retain seeds with abundant endosperm and small embryos.

The Illiciaceae and Schisandraceae have abundant "ethereal oil cells" and other characters suggestive of the first category of Ranales, but form tricolpate or hexacolpate pollen. Furthermore, the Schisandraceae, as certain of the Monimiaceae and Hernandiaceae, exhibit transitions between syndetocheilic-appearing stomata and haplocheilic stomata. Conversely, the Nymphaeaceae are in general more nearly comparable to plants in the sub-order Ranunculineae, but the Cabomboideae and Nymphaeoidae have monocolpate types of pollen, whereas the Nelumbonoideae form tricolpate ones. It should be noted, in this connection, that although the Piperaceae and Saururaceae have attained a high degree of morphological specialization in most of their parts, they contain characteristic "ethereal oil cells"

and have monocolpate pollen. They should be included in the Ranales, if this order is to be retained as broadly conceived of in the Englerian system.

The Tetracentraceae, Trochodendraceae (*sensu stricto*), Eupteleaceae and Cercidiphyllaceae have tricolpate pollen, haplocheilic stomata and, with the exception of *Tetracentron*, no secretory idioblasts. If these families are to be retained in the Ranales, it should not be upon unwarranted assumptions that they are closely related to, or directly derived from the Winteraceae, Magnoliaceae, or any other specific family of the order, but rather upon recognition of the order as a useful repository for relic plants that retain primitive, ancestral, dicotyledonous characters in one or more of their organs or parts. Nothing is to be gained by transferring such genera as *Tetracentron*, *Trochodendron*, *Euptelea*, and *Cercidiphyllum* into close relationship with the Hamamelidaceae or Saxifragaceae, since this would merely serve to expand another order into a less homogeneous assemblage. The only other alternatives are to include each relic genus in a special order of its own or to follow the lead of mycologists and establish a special assemblage, e.g. "Incognitales," comparable to the Fungi Imperfecti.

It should be emphasized in conclusion that much of the present confusion in literature dealing with the relationships and phylogeny of angiosperms is due to premature and unduly speculative generalization based upon excessively restricted and inadequate data. A much broader outlook is needed, involving the use of evidence from all organs and parts of plants and an accurate visualization of salient trends of specialization of such organs and parts in the angiosperms, and in the vascular plants, as a whole.

LITERATURE CITED

1. BAILLON, H. Nouvelles notes sur les Hamamélidacées. *Adansonia* **10**: 120-137. 1871.
2. BARGHOORN, E. S., JR. The development and phylogenetic specialization of rays in the xylem of dicotyledons. II. Modification of the multiseriate and uniseriate rays. *Amer. Jour. Bot.* **28**: 273-281. 1941.
3. BAILEY, I. W. & C. G. NAST. Morphology and relationships of *Trochodendron* and *Tetracentron*; I. Stem, root, and leaf. *Jour. Arnold Arb.* **26**: 143-154. 1945.
4. BESSEY, C. E. The phylogenetic taxonomy of flowering plants. *Ann. Missouri Bot. Gard.* **2**: 109-164. 1915.
5. BROWN, R. W. Fossil leaves, fruits, and seeds of *Cercidiphyllum*. *Jour. Paleontol.* **13**: 485-499. 1939.
6. CROIZAT, L. *Trochodendron*, *Tetracentron*, and their meaning in phylogeny. *Bull. Torrey Bot. Club* **74**: 60-76. 1947.
7. DIELS, L. A. Engler's Syllabus der Pflanzenfamilien, ed. 11. 1936.
8. HALLIER, H. Ueber den Umfang, die Gliederung und die Verwandtschaft der Familie der Hamamelidaceen. *Beih. Bot. Centralbl.* **14**: 247-260. 1903.
9. ———. Ueber die Gattung *Daphniphyllum* ein Übergangsglied von den Magnoliaceen und Hamamelidaceen zu den Kätzchenblütlern. *Bot. Mag. (Tokyo)* **18**: 55-69. 1904.

10. ———. Provisional scheme of the natural (phylogenetic) system of flowering plants. *New Phytol.* **4**: 151-162. 1905.
11. ———. L'origine et le système phylétique des angiospermes exposés à l'aide de leur arbre généalogique. *Arch. Néerld. Sci. Exact. et Natur.* ser. III. **1**: 146-234. 1912.
12. HARMS, H. Ueber die Stellung der Gattung *Tetracentron* Oliv. und die Familie der Trochodendraceen. *Ber. Deutsch. Bot. Ges.* **15**: 350-360. 1897.
13. ———. Ueber die Blütenverhältnisse und die Systematische Stellung der Gattung *Cercidiphyllum* Sieb. & Zucc. *Ber. Deutsch. Bot. Ges.* **34**: 272-283. 1916.
14. ———. Zur Kenntnis der Gattung *Cercidiphyllum*. *Mitteil. Deutsch. Dendrol. Ges.* **26**: 71-87. 1918.
15. ———. Zur Kenntnis von *Eucommia ulmoides* Oliv. *Mitteil. Deutsch. Dendrol. Ges.* **45**: 1-4. 1933.
16. HAYATA, B. The natural classification of plants according to the dynamic system. *Ik. Pl. Formos.* **10**: 97-234. 1921.
17. HOFFMAN, J. & H. SCHULTES. Noms indigènes d'un choix de plantes du Japon et de la Chine. Paris. Imprimerie Impériale. 1853. (reprinted from *Jour. Asiatique*, 1852).
18. HUTCHINSON, J. The Families of Flowering Plants. I. Dicotyledons. London. 1926.
19. LEMESLE, R. Les divers types de fibres à ponctuations aréolées chez les dicotylédones apocarpiques les plus archaïques et leur rôle dans la phylogénie. *Ann. Sci. Nat. Bot. Sér. XI.* **7**: 19-40. 1946.
20. LOTSY, J. P. Vorträge über botanische Stammesgeschichte **3**: Cormophyta Siphonogamia. 1911.
21. MATHIESEN, FR. J. Notes on some fossil plants from East Greenland. *Meddel. on Grønland* **85**(4): 1-62. 1932.
22. MAXIMOWICZ, C. J. Diagnoses breves plantarum novarum Japoniae et Mandshuriae. *Bull. Acad. Imp. Sci. St. Petersburg* **17**: 142-179. 1872.
23. McLAUGHLIN, R. P. Systematic anatomy of the woods of the Magnoliales. *Trop. Woods* **34**: 3-39. 1933.
24. NAST, C. G. & I. W. BAILEY. Morphology and relationships of *Trochodendron* and *Tetracentron*. II. Inflorescence, flower, and fruit. *Jour. Arnold Arb.* **26**: 265-276. 1945.
25. ——— & ———. Morphology of *Euptelea* and comparison with *Trochodendron*. *Jour. Arnold Arb.* **27**: 186-192. 1946.
26. PRANTL, K. Trochodendraceae. *Engler & Prantl, Nat. Pflanzenfam.* **3**(2): 21-23. 1888.
27. SHOEMAKER, D. N. On the development of *Hamamelis virginiana*. *Bot. Gaz.* **39**: 248-266. 1905.
28. SIEBOLD, P. F. & J. G. ZUCCARINI. *Florae Japonicae*, 111-240. (reprint from *Abh. Bayer. Akad. Wiss. Math-Phys. Cl.* **4**(2): 109-204. 1845; **4**(3): 123-240. 1846).
29. SMITH, A. C. A taxonomic review of *Trochodendron* and *Tetracentron*. *Jour. Arnold Arb.* **26**: 123-142. 1945.
30. ———. A taxonomic review of *Euptelea*. *Jour. Arnold Arb.* **27**: 175-185. 1946.

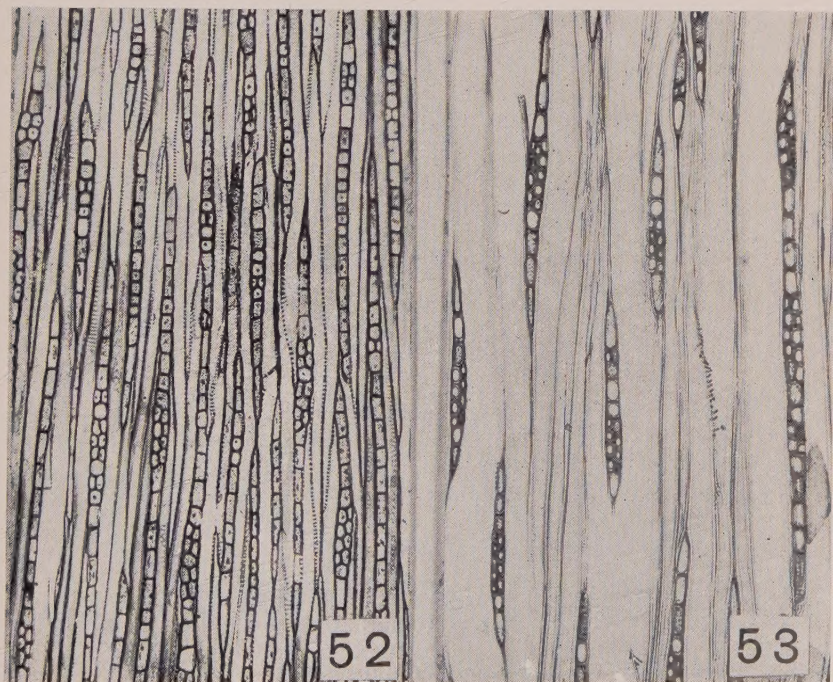
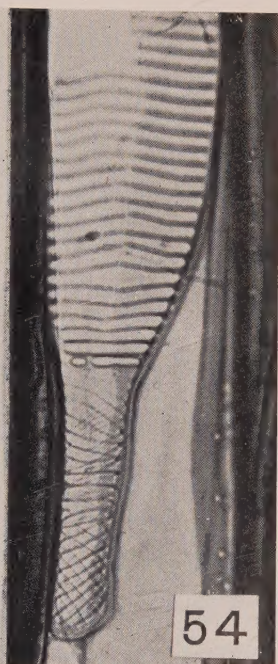
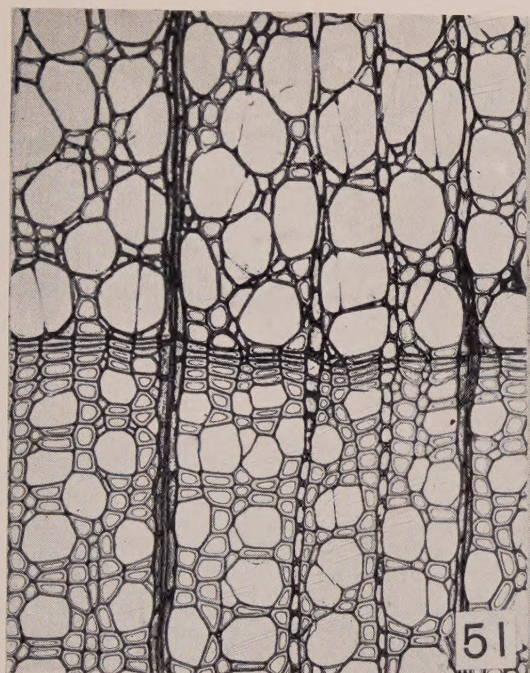
31. SOLEREDER, H. Zur Morphologie und Systematik der Gattung *Cercidiphyllum* Sieb. & Zucc., mit Berücksichtigung der Gattung *Eucommia* Oliv. Ber. Deutsch. Bot. Ges. **17**: 387-405. 1900.
32. SUGIURA, T. A list of chromosome numbers in Angiospermous plants. Bot. Mag. (Tokyo) **45**: 353-355. 1931.
33. TIEGHEM, P. VAN. Sur les dicotylédones du groupe des Homoxylées. Jour. de Bot. **14**: 259-297, 330-361. 1900.
34. TIPPO, O. The comparative anatomy of the secondary xylem and the phylogeny of the Eucommiaceae. Amer. Jour. Bot. **27**: 832-838. 1940.
35. TONG, K. Y. Studien über die Familie der Hamamelidaceae mit besonderer Berücksichtigung der Systematik und Entwicklungsgeschichte von *Corylopsis*. Bull. Dept. Biol. Canton, China, No. 2. 1930.
36. WHITAKER, T. W. Chromosome number in the Magnoliales. Jour. Arnold Arb. **14**: 376-385. 1933.

EXPLANATION OF PLATES

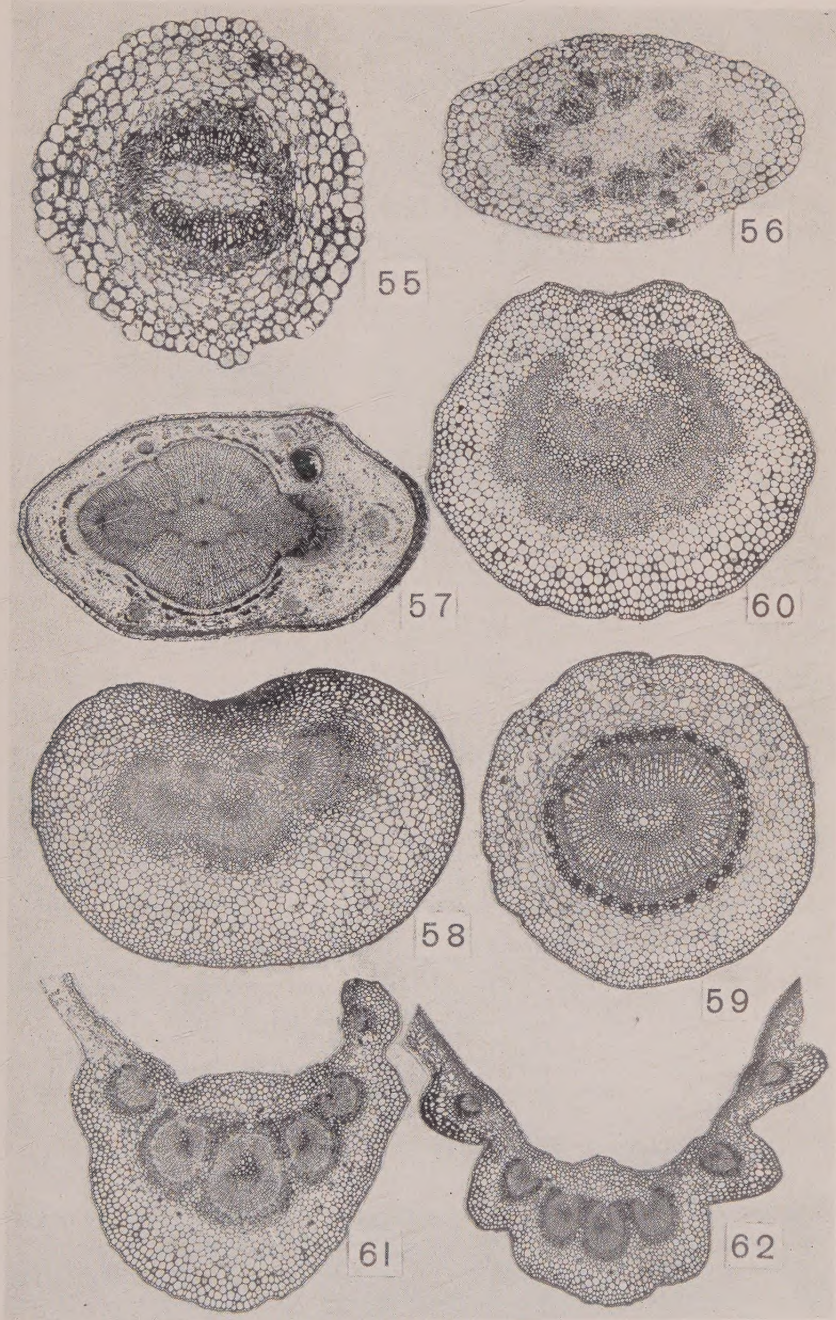
Plate I. *Fig. 51.* Transverse section of the mature wood, $\times 120$. *Fig. 52.* Tangential section near the early secondary xylem, $\times 120$. *Fig. 53.* Same, old secondary xylem, $\times 120$. *Fig. 54.* Part of a vessel member showing the spiral thickenings in the tapering end, $\times 320$.

Plate II. *Fig. 55.* Transverse section of a seedling at the cotyledonary node, $\times 40$. *Fig. 56.* Same, at the next node, $\times 40$. *Fig. 57.* Transverse section at the node of a twig, $\times 10$. *Figs. 58-60.* Transverse sections of the petiole at successive levels starting from the base, $\times 18$. *Fig. 61.* Transverse section passing through the base of the lamina, $\times 18$. *Fig. 62.* Same, at a slightly higher level, $\times 18$.

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